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SPECIAL NUMBER ON ECOLOGY AND ENVIRONMENT

Status of Environment in West Bengal

Calcutta's Air Pollution

The Dam — Its Past, Present and Future

Save our Earth : An Ecosaga of Humans

Peace with Nature - Long live the rich

The Problems and Prospects of Tourism at Digha

The Tribes of Andamans : Their Struggle for existence

Darjeeling Landslides - A Geoplanning Exercise through Geographical Information system for Future Development

Book Review - Contemporary Studies in Human Ecology

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STATUS OF ENVIRONMENT IN WEST BENGAL

*A. K. GHOSH**

1.0 Introduction

The development process in the post-independent India witnessed a significant change in terms of resource utilisation and population growth. The centralised planning process emphasised heavy investment on industrial development including power generation but also lent support to augmentation of irrigation, production of fertiliser and use of high yielding varieties of seeds to ensure food security. In the process, the quantum and quality of water, air, soil, forest, mineral and other vital resource base underwent drastic changes. The impact of development of Science and Technology on Environment became a subject of serious investigation during last two decades (1980-2000) but an initiative for management could be noted with the enactment of legal instruments to protect wildlife and water quality in 1970's and setting up of separate wing/organisation in 1980 for environment. This was followed by a series of new environmental legislations pertaining to both physical and biological environment.

Since 1980's some State Governments, considered the necessity of preparing Status of Environment Report at the State level, although the first published Country level reports were brought out by Centre for Science and Environment (CSE), a New Delhi based NGO. Mention may be made of Reports on Sikkim (Dept. of Env., Govt. of India) Tripura (Env. Dept. of Tripura), Gujarat (Gujarat Ecology Commission), Orissa (NGO), Arunachal Pradesh (Tata Consultancy Services, Govt. of Arunachal), etc. The purpose of all such reports are apparently to main stream environment policies into developmental process. How successful are the efforts can only be seen in post-report development scenario.

The first study of Status of Environment in West Bengal was initiated by Department of Environment, Government of West Bengal in 1997. The present author being the designated project Director, had the opportunity to design, conceptualize and prepare the report with a team of experts and associates. This paper is based on the Report, now published by DoE in 1999.

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* Director, Centre for Environment and Development, Kolkata

2.0 Methodology

The report on the entire geographical area of a State can be based on primary data collection or by collecting data from secondary sources, filling-up the identified gap within the time-frame of the project and present an analytical interpretation. In the present study the second approach was adopted.

3.0 Planning and Approach

The report was planned to be prepared in three parts, Part I, refers to environmental resources e.g. Groundwater, surface water, Soil, Minerals, Forest, Biodiversity in the given background of physiography and climate, Demographic changes and Urbanisation. The Part II refers to Developmental Impacts on Environment e.g. on Land use, Quality of water, Quality of air & noise, Health, Human habitat, etc. The last part focuses on the current efforts to improve the environmental status, legal and administrative policy wise and role of civil society in such efforts.

4.0 Resource and Impact of Development

The major resource bases and impact analysis can be planned on a sectoral basis.

4.1 Water Resource

The major surface water system in the State is confined in the Ganga catchment covering 15 of the 17 districts in an area Of 74,720 sq. km. followed by Bramhaputra basin with 10,670 sq. km. and Subarnarekha basin with 3270 sq. km. The drainage basins account for nearly 47%, 40% and 3% respectively of the total available surface water, rest being contributed by other sources.

The ground water resource can be grouped under Himalayan and Sub-Himalayan zone. Crystalline and rocky uplands of Purulia, Western Bankura, Medinipur, Birbhum and Bardhaman districts, the low lying alluvial plains of the northern, central and southern parts of the state. The ground water availability significantly varies in different zones as also the natural qualities of the ground water in terms of mineralisation, specific conductance and chloride level.

The major impact of surface water was recorded from the pollution load in the river Ganga, in terms of total solids, dissolved oxygen and bacteria - total coliform and faecal coliform, the extent of pollution being highest in all the river basins near urban centres. No systematic data are available for Bramhaputra and Subarnarekha basin. However, an estimate of pollution load from domestic sources could be given (Table 1). It shows nearly three times pollution load from rural domestic sources in comparison such urban sources. Further, the presence of heavy metals and pesticides in three selected commercially important fish species in Hugli estuary can call for serious and immediate action (Table 2 & 3.

Table - I

A Profile of Pollution from Domestic Sources

Basin & Sub-basin	Organic Pollution from Domestic Sources		
	Rural	Urban	Total
Brahmaputra	**202049**	**27171**	**229220**
Raidak II & Sankosh	11549	145	11694
Torsa & Raidak	70072	8370	78442
Jaldhaka	35560	11021	46581
Teesta	35560	11021	46581
Ganga	**2038038**	**824712**	**2862750**
Mahananda & Atrai	161124	36440	197564
Bagmari & Pagla	51868	5608	57476
Jalangi & Churni	14070	38336	52406
Mayurakshi & Babla	138150	12857	151007
Ajoy	64815	23115	87930
Damodar	160771	81807	242578
Rupnarain	276796	22481	299277
Haldi & Kangsabati	201580	23920	225500
Rasulpur	97510	2116	99626
Tidal Rivers	363430	301104	664534
Subarnarekha	**59518**	**2499**	**62017**
Total	**2299605**	**854382**	**3153987**

[Source : State Pollution Control Board]

Tabel - 2

Presence of Heavy Metals in Fish of Hugli Estuary (Mg/gm)

Fish→	**Hilsa**		**Sardine**	**Lixa Persia**
Location→	**DH**	**KD**	**HP**	**SD**
Heavy Metals↓				
Ni	0.41	0.59	0.50	0.81
Cr	0.47	0.64	0.04	0.73
Zn	12.84	17.77	15.81	15.37
Fe	30.85	32.84	32.10	28.92
Mn	4.25	7.15	0.92	3.39
Cu	2.23	2.81	1.89	1.86
Pb	2.23	3.39	30.85	5.02
Cd	ND	0.11	0.08	0.08

[Source : Status of Environment in East Bengal]

Table - 3

Presence of Pesticide in Fish (mg/gm)

Fish→	**Hilsa**	**Sardine**	**Lixa Persia**
Location→	**DH & KD**	**HP**	**SD**
Heavy Metals↓			
BHC	1.50–1.83	1.35	2.14
DDT	8.16–13-26	0.18	1.90

[Source : Status of Environment in West Bengal, 1997]

[N.B. : DH = Diamond Harbour; KD = Kakdweep; HP = Haldia Port; SD = Sagar Dweep]

One of the major impacts of development in urban areas could be noted in critical decline of peisometric level of groundwater. The capital city of Calcutta showed a decline between 3 m - 9 m in different parts of the city over a period of 20 years. Further, arsenic contamination of ground water in at least seven district of West Bengal viz. 24 Parganas (North and South), Nadia, Bardhaman, Murshidabad, Maldah and West Dinajpur covering more than 40% of the total geographical area of the State with 45% population led to serious investigation.

Maximum arsenic content occurs at 20-60 m depth but higher concentration is noted elsewhere at 79-85 m depth. The impact of arsenic contaminated water on human health calls for urgent mitigatory measure. High rate of groundwater withdrawal during dry season may have triggered off geo-chemical changes resulting in the decomposition of iron-pyrites in the surrounding rocks and subsequent release of arsenic. Besides arsenic contamination, flouride concentration has been detected in a large area from the identified village of Nasipur in Birbhum district. At least four district namely Birbhum, Bardhaman, Bankura and Purulia are now reported to have higher concentration of fluoride, affecting public health by way of dental flurosis, skeletal and non-skeletal flurosis, the most easily identifiable one being immobility due to skeletal flurosis.

4.2 Soil Resources :

At least six different soil groups based on climate and vegetation profiles are identifiable in the State, in six agro-ecological sub-regions namely Warmer Humid (Darjiling Hills), Warmer or Hot Humid (Terai) Hot Humid (Duars), Hot Moist sub Humid (Indo-Gangetic Plains), Moist Sub-Humid (Coastal area) and Hot Dry Sub-Humid (Western Districts).

Problems related to soil in the state, include soil depth limitation (very shallow to moderately shallow; 474000 ha.), soil drainage limitation (very poor to extremely drained area of 4439000 ha.), soils under limiting textural classes e.g. sandy (14000 ha.), gravely loam (488000 ha.) and clay (1551000 ha.), water logging limitation 1257000 ha.) and surface flooding (1950000 ha.); together these limiting factors variably affect 63.30% of the area of the state.

Land and soil degradation due to development is most remarkably noted in the coal-mining area of Raniganj Coal Field (RCF). Reclamation of degraded area has been insignificant. Opening up of new roads are unplanned development in Darjeeling hill area led to an increase of landslide and at least 200 sites of slope failure have been identified, between 30 degree to 40 degree slope zones by Geological survey of India.

4.3 Mineral Resources

The state of West Bengal has deposits of Coal, China clay, Dolomite, Fire clay, Apatite, base metals, etc. of which coal deposit is considered most significant. About 2000 sq. km area of open-cast and underground mining operation can be recorded in Eastern Coal Fields in Bardhaman and Birbhum districts. One of the best quality of Dolomite was extensively mined in Buxa Hills (Jayanti Hills) of North Bengal, till recent times.

The major impact of coal mining can be assessed from physical degradation of land area in 110 coal mines (turning into wasteland) high density of suspended particulate matter in the air and critical water quality of river Damodar. The lack of health records of colliery workers made it impossible to assess the percentage of workers suffering from tuberculosis and silicosis and other respiratory ailments but the available air quality data amply lends supports for such a possible scenario.

4.4. Forest Resources

The forest resources of the state can be categorised into seven different forest types, covering 13.4% of the total geographical areas; of the total forest, 59% form Reserve forest, 32% form Protected forest and only 9% belong to unclassed forest. The forest cover appears uneven in distribution at the district level. While the district of South 24 Parganas has highest forest area of 4263 sq. km lowest forest cover is noted in the district of West Dinajpur (18 sq. km), Murshidabad (8 sq. km.) and Hugli (3 sq. km.).

The adverse impact of development on forest area has been negated through some unique efforts like Joint Forestry Management (JFM) with people's participation in most of the districts of the state. Major decline in forest cover has been noted in Assansol-Durgapur belt of industrial area from 5.5% to 4% during 1980-1990. The use of Non Timber Forest Produces (NTFP) has been encouraged through JFM as a part of benefit sharing. The Social forestry programme of the state has been lauded over the years specially with involvement of gram panchayat.

However on the other hand, the illegal timber trade data, through records of confiscation was not available for the present study. The impact of recent ban of saw mills within close vicinity of forests and subsequent mushrooming of saw mills in periurban areas calls for serious investigation as to the sources of raw materials, its legal sanction or otherwise.

4.5 Biodiversity

The state has significant level of biodiversity both at ecosystem and species level. The Himalayan system, forest in Duars, Terai and elsewhere, vast areas of wetlands are river basins, the semi-arid zone of western region, the coastal areas and finally mangrove forests in Sundarban delta provided opportunities for species diversity in different ecosystem.

The faunal diversity in the state varies between 10% to 48% vis-a-vis India in 2.7% of the geographical area of the country. Himalayan region in the east offers richest faunal and floral diversity with highest percentage of endemism; over 50% of Orchids from India are known from this area. Of the flowering plants of India, more than 12% occur in West Bengal. Sundarban mangrove forest offers. 70 species with largest number of Tree-mangrove species in the subcontinent. The state has 5% of the geographical area and 37% of the forest area under conservation network.

The impact of development on biodiversity has been significant in areas of periurban wetlands. More than 75% of the biodiversity amongst plants, birds and mammals from the Salt Lake area in Eastern part of Calcutta has been lost due to reclamation of the water spread area. The massive collection of prawn seeds in Hugli Matla estuary region is significantly reducing the future survival potential of a number of fish species (at least 25), where juveniles are destroyed in the process. The State has at least 20 species of mammals in the endangered list. Of the birds, pink headed duck has become extinct since long. Bengal Florican, once widespread in the grasslands of Terai has become very rare. The reticulate Python and three of the marine turtles found in the State are in the Red List. Crocodiles, monitor lizards, snakes, turtle and tortoise as a group have become major components of illegal trade. The habitat destruction is reportedly impinging on the population of Himalayan Newt, a large number of orchids and epiphytes and medicinal plants. Likewise land use changes and massive invasion of high yielding varieties of seeds, led to large scale yet to be estimated, loss of flok rice varieties and vegetable crop varieties during 1965-2000 period. Data on population status of breeds of domesticated animals are sadly lacking.

4.6 Urbanisation

At least 28% of the population, as per 1991 census live in urban sector. The rate of urbanisation in the state is reported to be above national average. The process however appears uneven in the district level, the districts of Bardhaman, Hugli, Murshidabad, West Dinajpur, Jalpaiguri, Darjiling, 24 Parganas (North & South), Haora and Nadia showing significantly higher decadal growth rate, while Bankura and Purulia show the lowest growth rate of the urban areas, Calcutta Urban agglomeration account for 72.5% of the total urban population in the State in 1991.

While the urbanisation process shows a skewed growth pattern, the impact of rural land use has been significant. The loss of peri-urban agricultural land around the capital city, forest land for both civilian and cantonment expansion, and on large number of wetlands has never been documented in a systematic manner. The unplanned growth at the cost of environmental degradation is best witnessed in the capital city; while several Technical reports warned against conversion of low-lying and wetland areas in east Calcutta. The trend of development clearly indicates a complete violation of such recommendations with impurity. The alarming fall of peisometric level in Calcutta over 1960-1997 also calls for serious attention with possibility of subsidence in the areas of high water abstraction. The impact of unplanned urbanisation in hill region of Darjeeling, Kurseong, Kalimpong and Mirik resulted in a repetitive series of landslides, specially due to blockage of "Jhoras" and lack of appropriate building rules. Much of the urbanised areas of the state remain without piped water supply, sanitation and solid waste disposal system resulting in an ever increasing environmental problem.

While 72.52% population live in 37,910 villages and rest in 379 towns, the access to safe drinking water supply and sanitation remains dismally poor; of the 84 municipalities only 5 have underground sewers, 50% of CMC areas still lack underground sewerage and drainage. In the fastest growing Siliguri township, per capita water supply per day remains below 10 litres. CMC and HMC produce 120 Mt. of hospital solid waste, yet without proper disposal system; only 60 of 141 CMC wards have collection facilities for solid waste.

4.7 Human Resources

The human population of the State, estimated over six crore eight lakhs are largely employed in agricultural sector. Most of the marginal workers and non workers are women. More than 44% of the main work force in the state is engaged in urban and periurban areas. More than 28% of the total population live in urban areas.

The major impact of environmental degradation on human health are from unsafe drinking water, air quality in the urban area with much higher concentration of suspended particulate matter (400 μg) and increasing NO_2 (100 μg), lack of solid waste and hazardous waste disposal system, high noise level, etc. The alarming rate of gastro enteric diseases and respiratory diseases could be linked with water quality and air quality. The high incidence of vector borne disease likewise can be related to absence of proper sanitation in more than 75% area of human habitation. Only 101 municipal and non-municipal urban bodies out of 388 have solid waste disposal system. Nearly 4 million people live in arsenic contaminated areas. Monitoring of occupational health hazard remain very poor, with recorded 4367 visits by officials of the department in 2.7 million working man days. In 75% of the cases out of 40 identified units producing toxic substances, concentration of airborne chemicals with known health hazards exceeded the permissible limit. In 92% of all factories in the state continuous noise level exceeded the permissible limit. The work environment in stone curshing units led of death of four workers in the state; subsequently rulings of the Supreme Court and directives issued by the State pollution Control Board were seen to be openly violated in more than 100 such units in Mallarpur, Birbhum district bordering Bihar.

Numerous chemicals and process used in industries are carcinogenic but no data is available on the health impact of Asbestos, Vinyl Chloride, Lead, Cadmium, Arsenic, Nickel, Aromatic amines handling units in the state.

The process of urbanisation also reveals a close link with the process of industrialisation. Since zoning in the urban areas for industrial, residential, commercial and institutional purposes are never strictly followed, the impact of industrial activities on air quality of urban areas can be revealing. In the air quality status of Calcutta. Suspended Particulate Matter (SPM is recorded as high to very high and in Haora as very high. While oxides of nitrogen (NO_2) is recorded to be very high in Haora and medium in Calcutta. Data on Respirable Particulate Matter (RPM) which can lead to serious bronchial diseases, or data on lead and carbon monoxide as prescribed by CPCB for National Ambient Air Quality study, was not available.

The other impact of urbanisation on human health is related to noise pollution. Increasing trend of hearing loss, high blood pressure, psychiatric mental disorder can result from exposure to high noise level at traffic inter section of Calcutta; and noise level during festival season showed alarming trend (87-94 dBA as against standard 55-65 dBA). However, due to recent intervention of Calcutta High Court in responses to Public Interest Litigations (PIL), the situation has improved.

5.0 Discussion

The status of environment for the state of West Bengal as discussed earlier provides necessary input to integrate planning and development process with due consideration to environmental conservation. Obviously mitigative measures through public awareness, command and central principles for the identified problem areas are urgently called for. On the other hand future developmental exercise carried out by different departments/ ministries ought to mainstream environment to prevent degradation of natural resources and increasing pollution load, loss of biota, addition of gaseous emission contributing towards climate change and to ensure a process of sustainable development. Unfortunately the major planning agencies for infrastructure development, for e.g. West Bengal Industrial Infrastructure Development Corporation (WBIIDC) or West Bengal Industrial Development Corporation (WBIDC) have no regular linkage with the State Environment Department and State Pollution Control Board. Appropriate advice and counsel at the planning stage to focus on the need of integrating environmental requirement (even where no EIA is mandatoyr) is essential. The proposed growth centres in North Bengal (Dabgram, Raninagar and Cochbehar) sadly lack evidence of environmental planning with traditional infrastructure development. For instance, demand and supply requirement of groundwater vis-a-vis reserve and annual recharge, discharge and treatment of waste water through CETP, monitoring of air and waste water quality, disposal plan for solid waste and zoning of green, orange and red categories of industries, etc. are sadly lacking in all such plan documents, while allocations of land for different industrial units have already been made.

The present trend of urban development in East Calcutta also calls for serious examination and total ban. While planning documents of State Planning Board (1900-2011) and CMDA (1990-2005) strongly pleaded against such activities, the present trend bears contrary evidences e.g. (Rajarhat Township, Central Leather Complex and other project). The lack of infrastructural support facilities and inadequate manpower at the State Environment Department and Pollution Control Board seems to be one of the major constraints in achieving a better environmental profile of the State. This is in spite of a set of legal instruments enacted both at the central and at the state level. While public awareness has positively increased and judicial intervention in several cases (due to PIL) are evidenced, the limitation of functions of competent authorities continue to loom large.

The lack of policy implementation with regard to provisions of Town and Country Planning Act adopted in 1982, led to development without land-use control. The absence of adequate monitoring mechanism seems to have compounded the process of degradation of resources and environmental quality. The state is endowed with rich water and land resources, an excellent ecosystem diversity and assemblage of biota, offering opportunities to utilise the base for agricultural and fisheries productivity. In agricultural sector, restoration of traditional rice varieties, increasing pulses growing areas and integrated pest control can provide a sustainable development scenario. More specially, the focal areas for development in fragile ecosystem of Darjeeling Himalayan region and Coastal areas of Medinipur and South 24 Pargana, specially the Sundarbans, need a carefully designed environmental action plan.

Above all a sectoral integration of well designed environmental action plan is deemed essential for improving status of Environment in West Bengal. The role of civil society with an clear objective of participatory management has to be emphasized in implementing any state level action plan.

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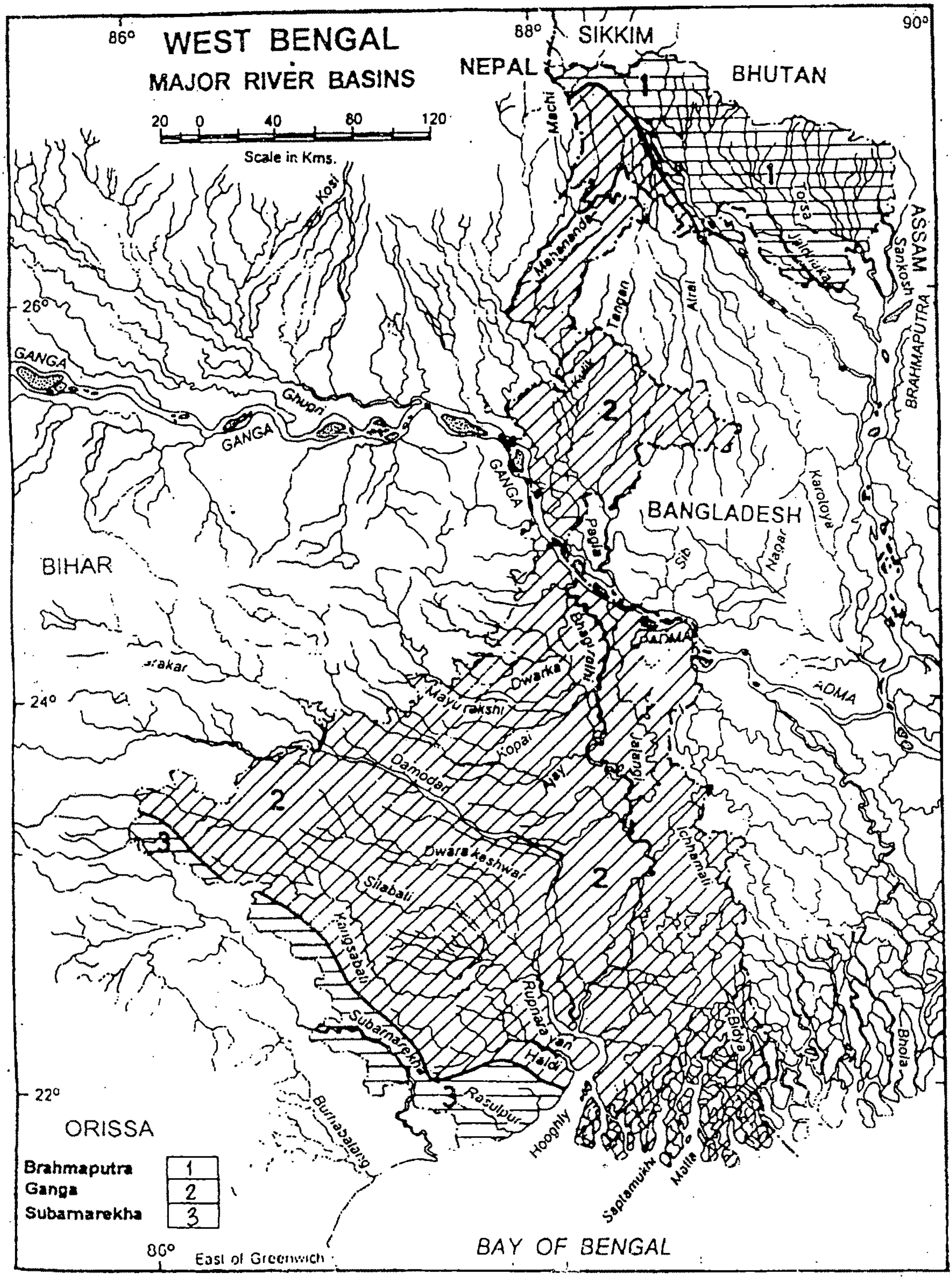
DoE 1999. *Report on the Status of Environment in West Bengal.* Department of Environment, Government of West Bengal, 270p.

NOTE : The paper is based on the lecture delivered by the author at the Netaji Institute of Asian Studies in 1999.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88°
90°
26°
24°
22°
86°
East of Greenwich
SIKKIM
NEPAL
BHUTAN
ASSAM
BIHAR
BANGLADESH
ORISSA
BAY OF BENGAL
BRAHMAPUTRA
GANGA
Ghugri
Kosi
Mechi
Mahananda
Tangan
Kulik
Atrai
Torsa
Jaldhaka
Sankosh
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Dwarka
Mayurakshi
Kopai
Ajay
Jalangi
Damodar
Ichhamati
Dwarakeshwar
Silabati
Kangsabati
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Rasulpur
Burhabalang
Hooghly
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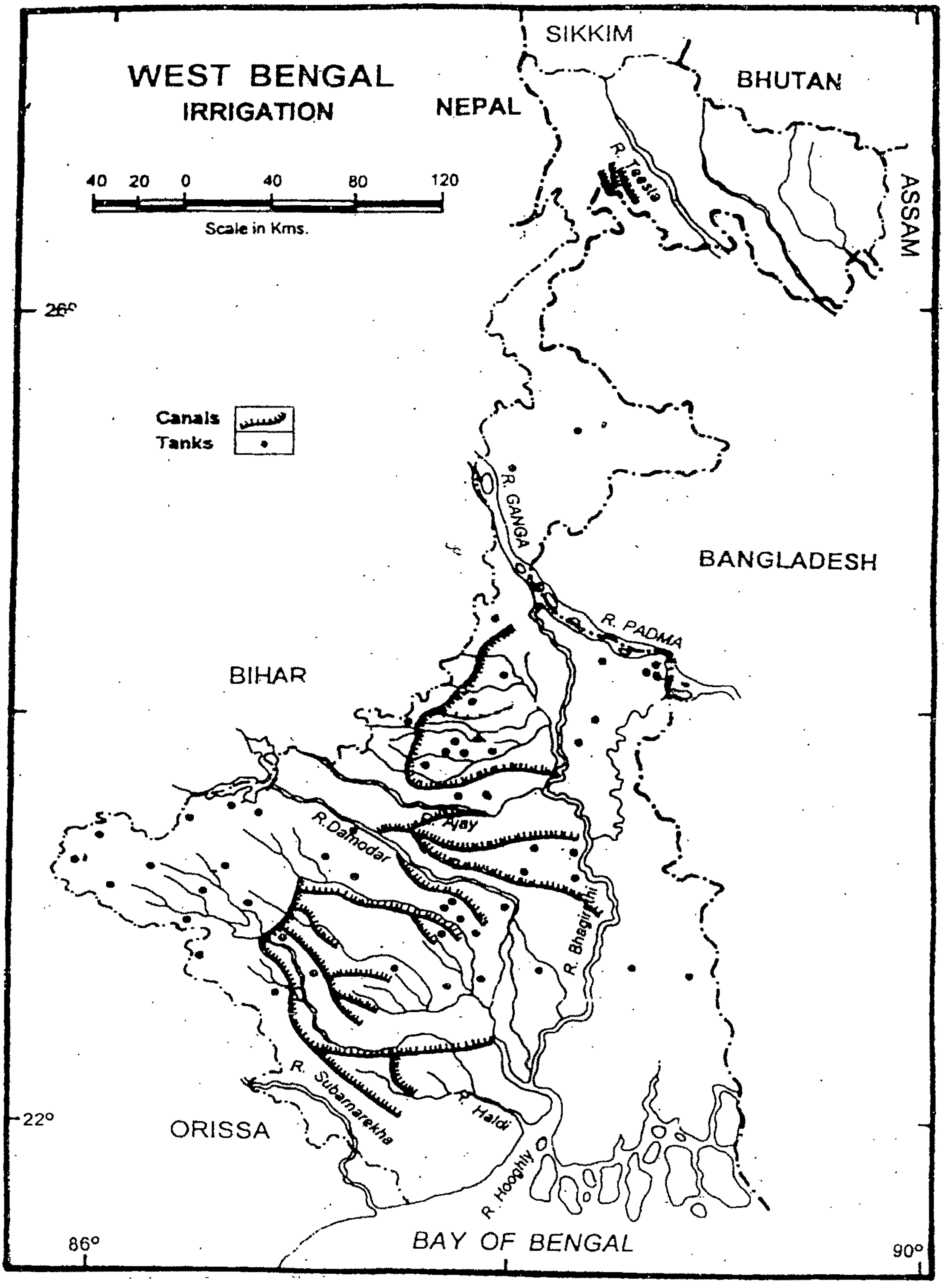
Map 09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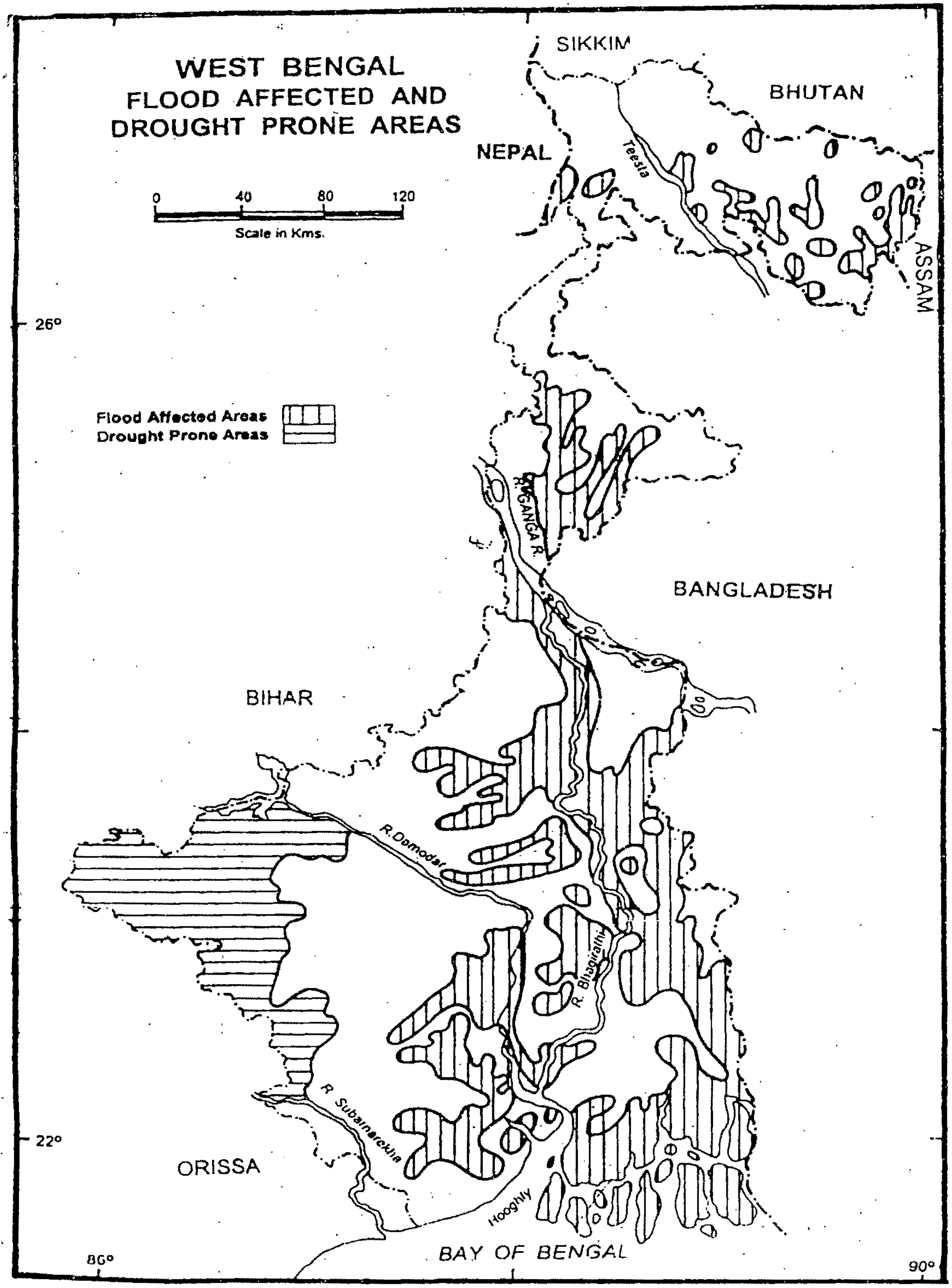
Map 20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FLOOD AFFECTED AND
DROUGHT PRONE AREAS
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Scale in Kms.
Flood Affected Areas
Drought Prone Areas
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BHUTAN
NEPAL
Teesta
ASSAM
26°
R. GANGA R.
BANGLADESH
BIHAR
R. Damodar
R. Bhagirathi
R. Subarnarekha
Hooghly
ORISSA
22°
86°
BAY OF BENGAL
90°

Map 25

CALCUTTA'S AIR POLLUTION

*PRANABES SANYAL**

Air quality in Calcutta of-late has become a matter of concern for everybody. The principal source of air pollution can be categorised into three main categories namely (I) Industrial sources (2) Domestic sources (3) Auto emission.

Since 1978 National Environment Engineering Research Institute (NEERI) has been monitoring the levels of air pollution for three main categories of pollutants namely Suspended Particulate Matter (SPM), SO_2 & NO_X. According to NEERI's findings the ambient air quality of the city of Calcutta furnishes the following average annual figures from 1993 to 1997.

Ambient air quality of Calcutta city ($\mu g/m^3$)
Annual Average Figures

Year	SPM	SO_2	NO_X
1993	550	44	45
1994	250	25	60
1995	350	35	30
1996	500	30	30
1997	250	20	30

(Source NEERI, 1997)

It will be apparent from the above table as well as from the attached graph that the level of SO_2 has come down from a peak of 90 $\mu g/m^3$ in the air in 1991 to a level of 20 $\mu g/m^3$ in 1997. Certain objections were raised against NEERI's measurement by WHO such as measurement of SO_2 is constantly at a lower level due to solvents not kept that at levels of 4°C. Considerable SO_2 escapes at room temperature solvents. The overall position of oxides of nitrogen particularly for Calcutta according to NEERI has come down from a peak of 140 $\mu g/m^3$ in 1985 to a level of 30 $\mu g/m^3$ in 1997. Apparently the principal source of NO_X should be the auto emission. Whereas the number of vehicles have increased from 2 lakhs in 1985 to 8 lakhs in 1998, it seems fallacious how NO_X could come down in such a manner.

---

* CCF (South), Director, Sunderban Biosphere, Govt. of West Bengal

The level SPM (annual mean) exceeds the critical level set up by Central Pollution Control Board for residential areas. The SPM is the most important pollutant in Calcutta air.

Air quality of Calcutta thus was measured during last two winters under special care through Centre for Study of Man & Environment (CSME). Following were the results.

Air quality in Calcutta during last two winters

Name of the pollutant	Central Pollution Control Board Standards (mg/m^3)	Concentration in Ambient Air in Calcutta (mg/m^3)	
		1997-98 (winter)	1998-99 (winter)
Suspended particulate matter (24 hours Average)	140-360	373	373
Nitrogen Oxides as no$_2$- (24 hours Average)	60-80	109	113
Carbon Monoxide (8 hours Average)	2286-5715	3935	5920
Sulpher Di-oxide (24 hours Average)	60-80	24	24

The principal source of air pollution in Calcutta has been identified by the CEMSAP project as below :

Priorities & Options, p 3.9) M. Tons/Day

Source	SO$_2$	SPM	NO3	CO	Total
Power Plant (Coal)	92	186	89	3	370
Industry	43	185	27	32	287
Traffic	5	7	140	266	418
Road dust	–	50	–	–	50
Domestic	10	21	5	85	121
Total	150	449	261	386	1246

Air Quality at 10 locations of Calcutta during September '97 (Monsoon)

Pollutant	Road Side (in µg/m^3)*	Ambient (in µg/m^3)*
SPM	830	200
NO$_X$	173	72
SO$_2$	50	17
CO	4788 (4.2 ppm)	3900 (3.5 ppm)
Pb	0.23	0.15
HC	300	200

** Average of all stations (CEMSAP)*

This apart Calcutta is also threatened by the pollution of lead which is 6.6 $\mu g/m^3$ during winter as compared to 0.463 $\mu g/m^3$ in Bombay & 5.35 $\mu g/m^3$ as compared to Kanpur.

Calcutta is also threatened by the most highly carcinogenic PHA i.e. Benz(a)pyrene. As compared with other cities of the world the position is as below :

Calcutta	**London**	**Brussels**	**New Jersey**	**Paris**
30-120 $\mu g/m^3$	2-14 $\mu g/m^3$	3.9-12.0 $\mu g/m^3$	0.69-1.06 $\mu g/m^3$	4.6-15.0 $\mu g/m^3$

From the chart of principal sources above it is apparent that the thermal plants are the main source of Suspended Particulate Matter and resuspension of dust is another cause of high SPM in Calcutta.

Carbon monoxide and Ozone were also monitored in Calcutta ambient air. It was observed that the level of Carbon monoxide is 3.5 PPM which is more than the prescribed safe limit. The level of Ground level Ozone is 300 ng/m^3 which is also two times that of US EPA standard. The distribution of ambient air quality within Calcutta will show that Salt Lake City is the most unpolluted area and Howrah Bridge Approach Road is the most polluted area of Calcutta as per following table.

Ambient Air Quality at 10 locations of Calcutta during December '97 to February '98 (winter)

Location	**SPM ($\mu g/m^3$)***	**SO_{2+} ($\mu g/m^3$)***	**NO_X ($\mu g/m^3$)***
Howrah Bridge approach Road	512.9	37.9	139.5
B.B.D. Bag	314.6	35.1	114.3
Shyambazar 5 Point X'ing	469.9	25.4	100.9
College Street-M.G. Road X'ing	277.7	19.8	114.9
Ultadanga V.I.P. X'ing	332.8	27.1	105.8
Moulali X'ing	325.5	16.0	148.6
Taratala X'ing	560.5	23.8	141.6
Gariahat X'ing	351.2	22.9	85.1
Hazra X'ing	326.5	18.3	104.1
Sector V Salt Lake	226.6	16.1	79.8

(Done through Centre for Study of Man & Environment, Calcutta)

Diesel in Calcutta is used 3½ times the petrol. 90% of diesel generated SPM is 1 μg size, which goes to alveolar membrane of lung. Two very highly carcinogenic compounds are generated from diesel exhaust. They are 3-Nitrobenzanthrone and 1, 8, dinitropyrine.

Auto Emission : About 50% of air pollution in Calcutta is due to automobiles. 48% comes from industries and 2% from domestic sources. The Calcutta Environment Improvement Committee formed under the chairmanship of Home Minister has examined the options for improving the quality of Calcutta's air with the following set of measures were proposed to be introduced, in July '99, but is yet to take shape.

A. AUTOMOBILES

(i) Existing Motor Vehicles

The number of motor vehicles registered with Public Vehicles Department (PVD), Calcutta as on 31.3.99 is 6.93 lakh. 45% of this number is two wheelers and 36% is Motor Car and Jeeps. We have, in addition, about 7,600 Buses, 1,100 Mini Buses, 24,000 Meter Taxis, 5,000 Luxury Taxis, 39,000 Trucks, 22,000 Vans and 10,000 Auto Rickshaws. Current exhaust emission norms are being made stricter (with effect from 1st August, 1999). Vehicles whose Pollution under Control (PUC) Certificates do not satisfy new norms will have to get refested and adjusted and will need certificates as per new norms. This will also be applicable in the rest of the state. The old and new norms are shown below :

a.	**PETROL VEHICLES**		
	% of Carbon Monoxide by volume	Old norms	New norms
i.	2 & 3 Wheelers with engine displacement <50 cc	5%	4.5%
ii.	Other 2 & 3 Wheelers	4.5%	4.5%
iii.	4 Wheelers	4%	3%
b.	**DIESEL VEHICLES**	70 Hsu	65 Hsu
	Smoke Standard Limits (Full acceleration)	(4.8 Bosch)	(4.5 Bosch)

(ii) New Private Non Commercial Vehicles (Both Petrol And Diesel)

(a) EURO-I : Mass emission standards will come into effect in Calcutta Metropolitan Area (CMA). No vehicle can be registered in CMA (registering authorities at PVD, Calcutta, Alipore, Howrah, Barrackpore, Barasat and Kalyani) unless they satisfy EURO-I norms.

(b) No vehicles can be registered with any registering authority in CMA with effect from 1.4.2000 unless they satisfy EURO-II norms.

(ii) TAXIS

In terms of rule 120(2)(c) of West Bengal Motor Vehicle Rules, 1989 taxi permit can continue beyond 15 years unless the vehicle is replaced. There is a provision to extend this period by 2 years by a Board provided that such extension can never exceed 5 years.

in total, current orders limit the total life of a taxi permit to 17 years. This order will be strictly implemented and the life of a taxi permit will be limited upto 15 years by 1.1.2001.

(iii) OTHER COMMERCIAL VEHICLES

In respect of Bus, Mini Bus, Truck, Van, Auto, etc. details are being studied by the Transport and Environment Department and a policy ragarding the age of retirement of such vehicles will be announced.

(iv) FUEL QUALITY

Government of India has been moved to :

a) Supply of 100% Lead-free Petrol in CMA;
b) supply of low Sulpher Diesel in the entire State;
c) supply of per-mixed Petrol – M. Oil for 2-3 Wheelers in CMA; and
d) supply CNG (Compressed Natural Gas) in Calcutta.

(v) GOVERNMENT VEHICLES/STATE RUN BUSES

a) Above vehicles will be required to follow pollution norms strictly.
b) Pollution check arrangement in CSTC/CTC/Government Pool Garage will be strengthened.

(vi) POLLUTION CHECK OF THE USE VEHICLES

a) Arrangements in PVD and Calcutta Police will be strengthened.
b) Auto Emission Testing Centres (AETC) will regularly be inspected. WBPCB will arrange special training for AETC operators. Number of AETCs will be increased in necessary.
c) Data in respect of violation of norms by vehicles detected by the Police and PVD will be computerised. Gross violation and repeat violators will also face action under the provisions of Air Act, 1981. They may also be liable for action in terms of section 258(2)(d) and 258(2)(e) of WB Motor Vehicle Rules, 1989 and in case of repeat violators their Certificates of Registration may be suspended.

(vii) SLOW MOVING VEHICLES

Rickshaws and Hand Carts will not be permitted in the main thoroughfares. 3 wheelers will not be permitted in the Central business district.

B. INDUSTRIES

(i) AIR ACT

The operation of Air Act is being extended to cover the entire state. Provision of Air Act are now applicable in CMA, Haldia Development Area and Assansol Durgapur Development Area. The notification will be issued shortly.

(ii) GREEN (LESS POLLUTING) INDUSTRIES IN THE C&SSI SECTOR

Green Industries in the C&SSI Sector, in respect of "consent to establish" and "consent to operate" under provisions of Air and Water Acts will not be handled by General Manager of District Industries Centers who have been declared as ex-officio Environment Officers of West Bengal Pollution Control Board. WBPCB will now concentrate on Orange and Red Industries.

(iii) IDENTIFICATION OF GROSS POLLUTERS

Gross polluters in the state both for air and water pollution have been identified. They have been put on a strict inspection schedule. In fact the 10% of total industries.

(iv) IDENTIFICATION OF CLUSTERS OF POLLUTING INDUSTRIES

Already 12 such clusters like Foundries, Rolling Mills, Lead Smelting Units, Glod Smelting Units, Galvanising Units, Ceramic Units, etc. have been identified. West Bengal Pollution Control Board is working regularly with them so that they follow norms by setting up pollution control measures. The efforts will continue.

(v) CLOSURE OF INDUSTRIES IN EXTREME CASES

When an industrial unit fails to respond after repeated attempts, strict measures including closures will be taken. Power and water supply in such cases will be disconnected.

(vi) POLLUTER PAYS PRINCIPLE

In appropriate cases, polluting units will be required to pay for restoration of damages caused by them. They may also be required to pay environment damage costs. This process had already been initiated.

In fine the Calcutta air has been found to cause silent bleeding and high alveolar macrophage accumulation in lungs of the Calcatians to the extent of ten times more than the residents of Sunderbans (control point). The road surface of Calcutta is 5.6% and the open space area is only 5.64% as against 25.5% prescribed by National Commission on Urbanisation (NCU). Where as NCU requirement is 290 sft. of open spacer per person for healthy leaving, the same at Calcutta is only 21 sft./head. So we need lot more breathing space and lot more Oxygen to dilute the pollution of Calcutta air by greening the city and preserving the wetlands.

THE DAM – ITS PAST, PRESENT AND FUTURE

*TARAK MOHAN DAS**

The total volume of usable water in our planet is not increasing, it is the same as it was in Roman times. Global water use tripled just between 1950 and 1990. More than 70 per cent of usable water is now consumed in agricultural fields for irrigation purpose where water is being wasted, mismanaged and polluted on a grand scale producing massive impact on the sustainability of the ecosystem. According to the reports from the United Nations and Stockholm Environmental Institute, by the year 2025, two third of the world's population will be affected by water shortage and the scarcity of water would become the sole limiting factor against maintaining the rising graph of crop production at par with demand.

Although the surface of the 'Blue Planet' is two-third water, 97% of it is sea water, while additional 2.31% is locked up in the polar icecaps, and less than 1% (0.69%) water accessible for human use distributed quite unevenly in rivers, lakes and at various depths of land surfaces. Almost all the terrestrial plants and animals are well accustomed with the scarcity of water in their environment and accordingly they adapt themselves with such environment through evolving various amazing body organs, like kidney, nephridia, etc., for repeatedly purification and recycling of water. Herbs, shrubs and trees growing in dense, virgin forests do not require irrigation. And rain-fed, single-crop cultivations do not pose any serious threat to the water reserve of the aquifers.

Now-a-days, the technologies of water management of crop fields have been developed centering round the dam-based irrigation network as well as shallow and deep tubewell-based irrigation systems. They are obviously not eco-friendly and as such require critical appraisal. Farmers mainly depend on these technologies because of the fact that the volume and frequency of rainfall are not uniformly distributed over the country and available at desired amount through out the year.

Since the birth of civilization, farmers and rulers have been impounding water. Eight thousand years ago, the Sumerians built an irrigation-based civilization between the rivers Tigris and Euphrates, then lost it to the salinization that now plagues some

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20% of Iraq's arable territory. By the first century BC, low dams had been built in the Mediterranean, the Middle East, Central America, China and India. Limited technology kept their height low. In India about 2,300 years ago, during the time of Chandragupta Maurya a massive Sudarsan dam was constructed in Gujarat on the confluence of three ancient rivers named Palasini, Sikta-bilasini and Arjikia forming a vast Sudarsan reservoir. The dam and the reservoir functioned perfectly well for nearly 1200 years. It was thoroughly renovated during the times of Skandagupta but ultimately the dam and the reservoir became totally extinct. Numerous dams were constructed with almost all the rivers of India, but none of them survived for an indefinite period of time solving the water crisis in agriculture on a permanent footing. Modern technology, perhaps, was first applied in construction of Veri dam on the Veri river by famous engineer Ballav Bhai Desai at the native state Gondal in Gujarat as early as 1900 AD. The height of Veri dam was 37 feet with 30 sluice-gates. It used to supply enough water through the year round for irrigation, industrial and drinking purposes for more than 75 years, but gradually stopped functioning due to heavy siltation.

Today, most of the world's large rivers are dammed. Worldwide, some 40,000 'large' dams (over 15m high according to the International Commission on Large Dams) and 800,000 smaller ones have been constructed impounding five times the volume of all the river-water. The technology of large dam was developed to improve human quality of life by providing drinking water and to support economic growth by diverting water for irrigation, power, navigation and flood, control. In many ways dams have succeeded. Late Prime Minister Jawaharlal Nehru saw them as the new 'Temples of development'. The dam-based irrigation systems have enabled India to be self-sufficient in food production since 1960s. It is an undeniable fact that the year round cultivations (2-3 crop/year) of high yielding varieties would not be possible without these dams. Dam-based irrigation on most of the arable land of Punjab has made this state as the granary of India. In addition, in many parts of the world, dams have helped to remedy life-threatening problems such as poverty from lack of economic development, famine as a result of drought, devastation from floods and continued disease from lack of potable water supplies.

But the adverse effects of river impoundments - disruption of ecosystems, decline of bio-diversities, forced resettlements, dam-based diseases and its temporary life-span have changed the perception of large dams and dam buildings to a great extent. The construction of gigantic dams in different parts of Asia, South America and Russia are still in vogue. China's most ambitious project since Great-Wall, the Three Gorges Dam will displace nearly two million people as it swallows up cities,

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villages, farms and the canyons of the Yangtze river. This 600 foot thick, mile-wide project is so large that it will be visible from the outer space.

The large scale displacement of people from the proposed dam site can be a death sentence to a community. Twenty years after, about 90,000 people were displaced from the site of a hydroelectric dam project in Ghana, none of them could be found, they simply disintegrated and perished.

Dam changes the chemical, physical and biological process of the river systems. They alter free-floating systems by reducing river levels, blocking the flow of nutrients, changing water temperature and dissolve-oxygen levels and impeding or preventing fish and wildlife migration. Tropical reservoirs and irrigation networks are also the ideal breeding ground for mosquitoes, snails and flies, the vectors that carry malaria, schistosomiasis and river blindness. Incidence of schistosomiasis, the long-term consequences of which can include pulmonary lesions, liver failure and bladder cancer, has nearly doubled since the 1940s. In many instances, infection can be directly correlated to the slow-flowing reed-filled water of irrigation canals.

Hydro-electricity has been shown very clean and cost effective, but planners for large dams have ignored numerous additional cost factors, including potential structure failure, changing or disruption of river-flow, reduction of life-span of the dam than anticipated figure and long-term environmental consequences. The hydropower is not so clean as depicted, the inundating vast wetland is a major emitter of greenhouse gases like carbon dioxide and methane and increases the catalysis of methyl mercury, a nerve toxin, from inorganic sediments. A badly managed hydropower project may produce more greenhouse gases than a coal-fired equivalent.

Large irrigation schemes have also proven not to be cost-effective compared to smaller, locally controlled operations. At the same time, it is impractical and poor strategy to oppose all dams on principle. In fact, there are many more good dams than bad ones. The bad dams are the shallow ones that flood large area of land and produce relatively little power and irrigation facility. By all accounts, large dam construction in developing countries is fraught with corruption. Frequently it costs more and take longer time than anticipated, sometimes to a grotesque degree. For example, the cost of building Brazil's Itaipu Dam, estimated at $3.4 billions over 15 years, expanded to $20 billions over 18 years. The cost of its production, electricity-unit also would be several times higher due to such overruns of capital expenditure.

The life span of a dam is inversely proportional to the silt-load deposited per unit area of the reservoir per unit time. Proper maintenance can extend its life span. The silt deposition can be reduced by checking erosion of the river bank through proper large scale afforestation programme or other effective means. The health of the network of irrigation canals also should be properly maintained which is often neglected. In fact, the maintenance of a water body is much more difficult and costly than maintenance of forested land of equivalent size. Most of the dam-based irrigation systems of our country are not properly maintained. At present there is no alternative for dams. But dam is not the answer for distant future of mankind. Every dam has got a fixed life-span mainly based on the rate of siltation. The water holding capacity of its reservoir is the maximum immediate after its construction, then gradually it is reduced with time and becomes totally defunct when it is full with sediment brought down by the river. The trouble starts when it is half filled with sediment, it could not hold all the water of the monsoon, the excess volume of water has to be discharged creating man-made floods in the surrounding localities. Ironically, this dam was once created for controlling floods.

The dam is the instant solution against water crisis but without any sustainable future. Hence, some of us may feel that sinking deep tubewells coupled with saving of huge wastage of water in agricultural fields is the feasible remedy for water crisis of the country like India. Irrigation by sinking shallow or deep tubewells, which has largely been practiced in India after independence, could not be alternative technology for the dam. Such practices have already created serious environmental hazards in various parts of the country, particularly where the rate of lifting outspaced the rep;enishment. In north western India, in Gujarat and Maharastra, fluorides are coming up with water. The arsenic problem is acute in many districts in West Bengal which was unkown before independence. In central and south India salinization of soils is rapidly increasing. Judicious irrigation with ground water taking all precautions, can be used as a subsidiary technology but can not replace the current role of dams. Worldwide over 40% of arable land is being irrigated by 840,000 large and small dams and water requirement in agriculture is doubling in every 20 years. Hence, considering the future requirement, we have to procure water by using all sorts of technologies, and specially from those potential sources which have not yet been largely tapped. At the same time, proper precautions to be taken to minimize their impacts on environment.

In Agricultural fields, a huge amount of water is simply wasted due to free evaporation and faulty water management. On an average, 80% of irrigation water is lost during transit before reaching the roots of crop plants. Crop plants themselves are also responsible for losing a considerable amount of water through transpiration. When one gramme of dry matter is accumulated in plants, 300-1000 gramme of water is lost through transpiration. 10 to 25 per cent of transpiration loss can be checked by spraying the crops with various antitranspirant agents, like PMA or soil emulsion. In fact, crop plants are somehow pampered by over irrigation. It has been shown that they could be trained to thrive with relatively less amount of water without hampering the yield. Raising the drought resistant varieties is another means to cope with the situation. But today, the most efficient technology to save water in the crop fields is the drip irrigation, also called micro-irrigation. The basic tool for drip irrigation consisting of a simple length of perforated pipe hooked up to a pump. In this Israeli-devised technique small amounts of water are directly applied to the plants roots through pipes buried along rows of crops. The method is 95 per cent efficient - meaning that 95% of water passed through the pipe is utilized by the crops - compared with as little as 20% in traditional irrigation. In this technique very small amount of water is lost to free evaporation or runoff. Today, drip irrigation waters at least 16,000 sq km crop field in two dozen nations - still less than 1 percent of all irrigated land.

When we look for a long term permanent solution, perhaps there is no other alternative than desalination of sea water which would sustain through millennium for unlimited consumption. Procurement of usable water from the polar ice-caps is also another possibility with hopeful future. Improved technology for low-cost distillation with solar power of atomic energy from fusion of hydrogen isotopes generated from heavy water or upgraded technology or reverse osmosis of sea water would be the ultimate answer for mankind of the next millennium. The life once evolved from the sea. No doubt, it would naturally have all its sustenance in the sea.

SAVE OUR EARTH : AN ECOSAGA OF HUMANS

*ASHIS SARKAR**

Abstract

It is the cause, it is the cause, my soul;
Let me not name it to you, you chaste stars!
Yet she must die, else....
Put out the light, and then put out the light....

The present tribe of scientists - physicists, chemists, biologists, oceanographers, geographers, historians, philosophers and sociologists – throughout the World, as did Othello, now find morally obligated to hold the 20th century pseudo-astonishing scientific and technical achievements as the causes of origin our dear old earth's sad future. They are now more concerned with the Hamletian Question : *What are the flash points in science? Which of its discoveries ultimately proved devastating for the human civilization?*

Introduction

In the boundless ocean of universe, our earth is indeed a unique ship sailing in a near circular orbit (*aphelion distance = 152 million km and perihelion distance = 147 million km*). Within the ambience of the Milky Way galaxy, its journey probably began about 4.5 billion years ago; in its orbit round the sun, it races in 365 days 6 hours 9 minutes and 10 seconds with an average speed of 30 km / sec. it carries aboard about 6 billion passengers and is reliably protected from solar and cosmic radiation and meteor showers by its atmosphere and its magnetic spacesuit. Its life-support system is fairly rational, naturally perfect and self-regulated as designed by the Creator *Unknown* or Creator - *X*.

Once in a while, the ship's crew and passengers feel fluctuations in pressure and temperature, suffer from excessive humidity and unprecedented drought or unusual hot spells and coolest glacial phases and uncertain collisions with cosmic wanderers. Underground shocks often provoke devastating earthquakes; fire-spitting volcanoes belch millions of tons of lava and ashes; tsunamis, tornadoes, hurricanes, typhoons etc crush all they encounter in their path. Nature's temper, thus, gives vent in a variety of ways making it alternatively kind and cruel to the humans. The phases are inevitable, destined and regularly cyclic in occurrence so that her passengers have to constantly adapt and readjust themselves with Nature / available environment. However, in her never-ending journey through the celestial universe, she doesn't have anytime to contemplate on these; it goes on forever and forever in time and space (Rebrov, 1989).

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It is unfortunate that some people on our planet seek destruction through mindless exploitation, war and killing... Yes, it's simply crazy and senseless, defying all explanation - the schizophrenic delirium of a mad man, indeed! It was they who, in the name of science, brought curse to the civilization; it was they who wish to establish their supremacy and rule the planet; it was they who unleashed world wars, dropped atom bombs on ecumens, released killer doses of biological and chemical weapons that slowly destroy the existing bio-habitats by transforming the natural reservoirs into dumping sites of nuclear wastes, by infusing more and more greenhouse gases (GHGs) into the atmosphere, by impregnating non-biodegradable chemicals through killer pesticides and insecticides... and by inventing more and more refined methods of mass destruction. These are all in the name of the Game of Power on Political frame.

The war-mongering, power-crazy nations are constantly threatening the socio-economic and political stability of the starving, yet peace-loving, tropical nations throughout the globe. They are planfully disconnecting the natural mother-child bondage between the physical environment and man by provoking them to lessen and uproot their indigenous symbiosis with the mother earth; this they achieve through constantly creating pressure on the poor masses in the form of look-a-like dazzling images of the cheap-virtual world, advertised by the neo-colonists / multinational corporate giants : *the illiterate millions along with the profit-motive rich layer form their ideal haunting ground for nature's bounty, their marketing arena, for which the fight is on since the age of exploration...*

World of Nature

Earth's physical world consists of four great material realms : gaseous (*of atmosphere*), water (*of hydrosphere*), solid (*of rocks and minerals*) and biosphere (*of all living organisms of the first three realms*). It's atmosphere is an uniform mixture of gases (*N_2=78.08%, O_2 = 20.95%, Argon = 0.93%, CO_2 = 0.035% + Other variable gases including water vapour, carbon monoxide, ozone, sulpher di-oxide, nitrogen oxides*) and other minor gases like, chlorofluro carbons, neon, helium, methane, krypton, hydrogen etc. at least upto the homospheric limit of 120 km. Of vital concern to humans and all other life forms on earth is the presence of ozone layer (15 - 55 km) within the stratosphere, that serves as a shield, protecting the biosphere by absorbing most of the UV - spectrum of insolation.

World ocean covers about 71% of the earth's surface area with an average depth of about 3800 m. The total volume of world ocean is about 1.4 billion cubic km, a quantity just over 97% of world's free water, the remaining 2% lies in the Polar ice-sheets and 1% in the fresh water in lands. Hydrosphere acts as the huge reservoir of water vapour and heat and has an immense potential of moderating earth's surface temperature, It sustains a vast and complex assemblage of marine life forms. The solid realm is composed of rocks and minerals in the three primary relief forms : *(mountains, plateau and plains).*

Environment - A System of Systems

The environment of a place, object, person or event is simply the set of surrounding conditions that act on it and give it a particular character. It occurs at a variety of scales : the global scale (i.e. *the whole Earth*), the regional scale (i.e. *the large divisions of Earth's surface*) and local scale (i.e., *the area that individuals commonly experience in their daily activities*). On global scale, there are four major natural environments : the atmosphere-ocean environment (*these are combined because of their important exchanges of heat, gases, water and small particles of solid matter*), the solid-earth environment (*consisting of the rocky part of the Earth that has its own internal source of energy*), the surface-relief environment (*the narrow zone where landforms are produced*) and the living-organism environment (*where portions of the other three major environments interact to form an arena for the existence of living organisms*). Each of these has an organized structure of various components and processes that link these components and are responsible for changes. Structure refers to its constituent elements (*chemical composition and physical properties of the atmosphere, oceans, continents and ecosystems; the minerals, rocks, landforms, plants and animals that are parts of the larger environment*) and their shapes and geographic distribution. The processes that produce these forms and link them together in environments are the energy pathways and the circulation of materials. Energy from the sun or from the Earth's interior, passes through the environments where it produces physical and chemical transformations. The continuous circulation of water, rock materials and plant nutrients results in environmental change and development (Bradshaw and Weaver, 1993).

At the global scale, processes in the atmosphere - ocean environment are fuelled by a daily replenishment of energy from the sun. All the energy in the solid-earth environment arises from within the Earth. The other major environments result from interactions between these two, since solar and internal Earth sources of energy produce a variety of outcomes. The substances forming the major environments are recycled repeatedly to provide continuing sources of materials. Atmospheric gases are added by the radioactive decay of minerals, by volcanic activity, by chemical reactions with surface minerals and by the living processes of plants and animals; these interact with other Earth environments. Water vapour is cycled through oceans and atmosphere and then over, and the through rocks. Wave action, volcanic activity, desert dust storms and human activities produce aerosols. Matter and energy flow-systems sustain the material flow-systems through several bio-geochemical and nutrient cycles (Ramade, 1984).

Earth's green kingdom contains about 200,000 species that drives its regeneration system by absorbing from the atmosphere about 5500 billion tons of CO_2 and returning to it about 400 billion tons of O_2. One hectare of forest can alone retain about 30 tons / year of dust, soot and ashes. A single tree produces in a day enough O_2 for three persons to breathe. The trees, shrubs, flowers and grass act as an unique biological filter to trap noxious chemical substances and are the noblest and greatest friends to the (*passengers*).

The Fact File in Brief

World Population is now over 6000 million, about 80% of which live in the less developed countries and the remaining in the developed countries. Population is still rising at an alarming rate : although the figure for developed countries is only 1.35% the corresponding figures for the less developing countries (Africa - 4.14%, Latin America - 2.49%) and also the World average are quite high - 2.77% and 2.48% respectively. By 2025, 4.3 billion people will be living in Asia alone, nearly 2.5 billion in its packed urban areas. Claustrophobic mayhem!

More than 80% of CO_2 emissions are caused by industrial activity and vehicular emissions - burning of fossil fuels, such as oil, gas and coal and cement manufacturing that creates CO_2 during limestone processing. CO_2, accounting for almost 55% of the emissions of the Greenhouse Gases (CO_2, CH_4, O_3, N_2O, CFCs, SF_5, CF_3 etc.) have trebled during the last 40 years. The annual per capita emission had to be at or below 1.69 metric tons to prevent additional CO_2 building up in the atmosphere. CO_2 levels in the atmosphere are at their highest in 20 million years. Six of the 10 warmest years ever recorded occurred in the 1990s, the remaining four happened in 1980s.

- Forests are giving way either to development projects, industry and housing, or are being replaced by commercial plantations. The worst hit is the tropical zone that houses the southern nations. Latin America, alone has suffered the worst casualties : by 1990, it had lost about 4.5% of what forests it had in 1980, but Asia's is the fastest annual depletion rate of 1.2%. Overall, the world has already seen 15.4 million ha of forests chopped away to serve other purposes, the global annual rate of depletion being 0.8%.

- Deforestation of closed tropical rainforests, containing at least 50% of all the world species, accounts for a daily loss of as many as 100 species ; the forest-fauna remains under severe threat. The increasing strain imparted to the natural environment by man constantly destabilizing the ecosystem through declining bio-diversity.
- Volcanic eruptions and earthquakes are becoming more frequent and more severe over the globe, belching out tons of lava, ash and gas into the atmosphere. A haze of pollutants in the form of clouds (3.0 km a.s.i), the size of the USA, covers a part of the Indian Ocean sky cutting off insolation and creating terrific fears of acid rain, low rainfall and a change in environmental politics.
- Natural lakes, marshes, rich mangroves and wetlands are fast vanishing. Cyclones, tornadoes, flash floods, cloud bursts, acid rains, floods and draughts are becoming more and more frequent. A super cyclone hit Orissa's ten coastal districts in the morning of October 29, 1999 and for about 8 hours, remained stationary with wind velocities rising to nearly 300 km/ph for almost 4 hours. Swept by such ferocious gales, the sea ingressed 15-20 km into the land with 9m high waves. The trail of death and devastation, in its wake shocked the whole world. The total human cost against all these hazards is very high for the present civilization.
- In the past twenty years, there is definitely a global warming @ 0.2°C/decade. As a result, sea ice is 40% thinner and covers 6% less area than in 1980. The Arctic ice cover is in retreat, shrinking by an area the size of the Netherlands every year. A massive iceberg, about the size of New York City broke off from the Antarctic Peninsula and a 64.4 km crack has developed recently in the northernmost part of the Larsen Ice Shelf that runs 965.4 km up the Antarctic Peninsula. Excess tropical heat is transported to the poles : About half of it through the ocean conveyer (a vast dep water circulation equivalent to about 100 Amazons) and the rest as energy in the storms that move poleward from the tropics.
- Global warming is threatening the earth's thermostat. During the last interglacial period - 18000 BP, global temperatures were 4^0 - 5^0C colder and the sea level 100 m lower. The increase in global mean temperature led to the melting of

the ice sheets covering large parts of Northern Hemisphere. Over the past 1000 years, the sea level has been rising by about 0.1 - 0.2 mm per year. The world's remaining ice cover contains enough water to raise the present sea level by over 75m. The Arctic is rapidly turning into a long-range dustbin not just for Europe but for many other parts of the developed world. The reason is : a quirk of the planetary circulation system, causing some of the most lethal chemicals, like poisonous mercury and toxic organochlorines to end up in places far from the maddening crowd, such as Svalbard, 1000 km inside the Arctic circle.

- The upper layers of the atmosphere are getting cooler; the mesosphere (50 - 90 km) has been cooling @ 1 C/ year for the last 30 years : this is much faster than expected. Experts believe that this is an ominous sign of the major changes that are to come in the global climate. Stratospheric Ozone holes are getting larger and larger both over the north and south poles of the Earth.
- Earth, the cradle of all life forms is being transformed into a graveyard for want of serious monitoring of soil degradation. Overexploitation, increasing salinity, faulty cropping practices and industrial pollution are threatening ground water resources. Measures to protect ground water, that accounts for 97% of fresh water resources - from the pressures and pollution it is encountering, need to be hastened. Arsenic pollution! Open cast mines, particularly coalmines are the principal terminators of ecosystem and society. Sullied are the Seas with oil spills from ocean liners and nuclear and chemical wastes! Dams and embankments built to control floods, have in turn, made life miserable in the long run - an engineered chaos. Sheer greed and neglect are ravaging urban wetlands, the lifeline of India's cities for centuries, protected by tradition and preserved by people. Criminal waste.
- Thousands of war have been fought since the first millenium, over 150 have broken out since 1945. War in the 20th century has killed more than 100 million people, of which about 69% can be accounted for by the World Wars I & II and 20% since 1945. Wars, international tensions, famines, draughts, floods, developmental projects, desertification, soil degradation and land erosion together, have given birth to millions of environmental refugees, who, being uprooted from their places of origin, indigeneous culture, economy, society and belief, comprise the tremendous exodus to the megacities of today.
- Cross-country and international frictions are mainly over the natural fund resource, specially the energy resources, distribution of which is typically uneven (sparsely concentrated), beyond human control, and the consumer markets.

However, nuclear technology proved dangerous (Cherennobyl! and hundred others) to the humans, both regarding leakage in the reactors and waste disposals.

Man's Labour Lost

Human beings are animals , more precisely heterotrophic organisms. Like all other living beings, they require matter and energy : *their metabolic requirements are met by the air they breathe and by the water and organically derived food they ingest; they depend on the cosmic system from which they have descended; essentially the sun and the ecosphere.* However, continual advances in technology have caused other needs to appear in addition to those resulting from natural biological processes. The development of an ever more complex industrialized society in which the production of manufactured objects is essentially growing entails a continuously increasing use of primary energy and of organic and inorganic raw materials. Just as metabolic processes involve the discharge of mineral and organic excreta, so the activities of a technological civilization release waste products into the environment. In both cases, the discharged material does not simply disappear from the environment that receives it, instead, it circulates in biological systems, which can cease to function properly if their homeostatic mechanisms are over-stretched (Ramade, 1984).

Explosive growth in population, along with the unending increase in per capita consumption of manufactured goods, puts great pressure on nature and natural resources. Thus, we are a way off one of the fundamental concepts of industrial civilization, that of *homo economicus*, which regards humanity as the owner of all mineral and biological resources and thinks of these resources as inexhaustible and to be disposed of, as we please. Thus, humanity is extraneous to the ecosphere and thus independent of any ecological changes in it that might be produced by human activity.

Through the continuous processes of labour, man has eventually been able at least partially to conquer Nature with all her belongings in the domains of environments. The dialectics of Man-Nature interaction as spelt out by Zimmerman (1951) is :

"...material needs are satisfied through the exploitation of natural resources, manifested in specific modes, organized with varying degress of efficacy and enhancing series of higher needs in the course of the progress of civilization." The whole experience with all its dimensions is a function of time that also saw changes in social fabric as well as its attitude towards environment. The human history shows a tremendous exploitation of Earth through the unending chain of innovations, completely disregarding the injuries caused to our dear mother Earth : *man has*

been so noisy about the ways he has conquered Nature and Nature has been so silent in her persistent influence over man that the balance of equation has been overlooked. Engles (1876), in his masterpiece, "The Part Played by Labour in the Transition from Ape to Man", warned us : Let us not, however, flatter ourselves over much on account of our human victories over Nature, for each such victory Nature takes its revenge on us; each victory, it is true, in the first place brings about the results we expected, but in the second and third places, it has quite different, unforeseen effects which too often cancel the first.

Thus, application of the latest achievements in science and technology has brought about a progressive pollution of the atmosphere, of inland waters, of world oceans as well as an erosion of soils, a brutal exploitation of the natural resources, a crowding of population in the gigantic cities (Goudie, 1981). A situation, thus is born which undermines the health of individuals and of societies and often causes irreversible damage to the society and environment. The modern term for all these eventuality is the ecological crisis i.e., a crisis of the entire system of mutual relations between societies and their environment. Man's labour lost (?)!

Overstraining The Ecological Base

Resource simply refers to any form of energy or matter necessary to satisfy the physiological needs of humanity or to sustain all the various activities leading to production. The flow patterns of such resources through human civilization are very complex and can be studies from various angles. Between the stages of extraction and consumption, resource undergoes many transformations that often have an impact on the overall functioning of the ecosystems in which the processes occur (Simmons, 1974). Industrial civilization was primarily based on non-renewable fund resources (e.g. metallic minerals, coal, other fossil fuels and etc) rather than the renewable flow resources (e.g., water and all resources of biological origin); the present technological civilization has more or less identical basis, although considerable conservation is being attempted through recycling and substitution. Plant and animal resources, although potentially renewable, are very often so overexploited that the possibility of regeneration in many parts of the world has been greatly reduced and sometimes completely compromised by the destruction of the ecosystems on which they depend.

The sun provides the energy base of an ecosystem; the energy fixing plants on the green earth surface act as the energy terminals. Not all the energy so fixed is available to the ecosystem as a whole, because a large proportion is utilized in the primary producer's own respiration. Therefore, it is the energy remainder or the net productivity of the ecosystem (NPE) that drives the ecosystem and provides the energy necessary for the first order consumers. Optimization of the efficacy of the hierarchic organization within an ecosystem occurs when the energy is distributed throughout the system via hegemony of food chains and food webs. Normally, the greater the number of consumers, the larger the energy base of the pyramid, as –

$$\mathbf{NPE = [\ GP - (R_1 + R_2)\ ]}$$

where, NPE = net productivity of the ecosystem, GP = gross productivity of the photosynthesizers, R_1 and R_2 = respiratory requirements of the producers and consumers respectively.

In developing or successional ecosystem, NPE is abundant. Obviously, it can support large population of few species. As the system matures, it increases in complexity and attains greater diversity of species with small populations. Population growth curve of any organism is S-shaped, the top of which is determined by the carrying capacity of the environment, as affected by alterations in environmental parameters, e.g., tectonic, climatic and anthropogenic factors. As the total energy available over the planet's surface didn't show any marked change, biomass and biosphere must show constancy and increase in any one species would always be at the expense of the other. This reduction in diversity of species, termed bio-diversity, increases the ecological instability. This is exactly what is going on since the Neolithic times and has only acquired momentum since the 19th century industrial revolution.

As population increases so does the demand for energy; base of the pyramid expanded through the use of fossil fuels and other innovations took place to subsidize the energy available to the producers. However, fossil fuels are fund resources and will be exhausted in remote future; the cost of alternative devices would be too high to be applied thoroughly throughout the societies and economies in all parts of the globe; immediately, hence the food web would loose linkages and the energy pyramid would face sudden destruction, bringing the ecological crunch and the end of us all. It is this overstraining of the ecological base that led to the demise of most past civilizations (Murdoch, 1971). The experts apprehend that similar causes are a sure threat to our modern technological civilization. In the process of subsidizing the energy at the producer's level, man is gradually transforming the natural ecosystems into artificial ones, the level difference is nothing but the environmental pollution. In terms of Doxiadis's metaphor, it is the mollusc itself that secretes the substance from which the shell is formed.

Global Scenario - An Appraosa

Global population explosion, specially in the LDCs is an established fact, the consequences of which are manifold : crowding of millions in the tropical countries of Asia, Africa and America; magnanimous urban growth in the cities of the above region; massive human encroachment on agricultural and forest lands; huge expansion of the frontiers of primary production to cope with the rising demands for parameters associated with food, dress and shelter (irrigation, chemical fertilizer, pesticides, insecticides, sanitation, hygiene, drainage, power, education etc); there will be more people in SE Asia's cities scrabbling for vegetables than its villages will be able to squeeze out of a desiccated land; crushing demographic pressures linked with high incomes and large industrial concentrations, are already creating giant environmental headaches in Asia's cities; more and more people opt for quicker transport, easy communication and fast life with all sorts of smart-comfort and easy-pace, the environmental cost of which is too large for the humans to sustain development (Wise, 1969; Hicks and Glickman, 1983; Gregory, 1987).

The pressure on bio-habitats is now spectacularly high and large; social and economic development is robbing us of the vital forest cover...? The depletion is causing major ecological damage, often completely destroying habitats, and uprooting peoples and cultures. forests help maintain the environmental conditions that make life possible, from regional hydrologic cycles to global climate. Frontier forests, large, ecologically intact and relatively undisturbed natural forests are particularly important as they store tremendous amount of CO_2. Entire tree species face the threat of extinction from CO_2 increase. Protecting and responsibly managing our last frontiers will help countries avoid paying the high costs associated with massive forest loss and degradation. History abounds with examples of civilization that floundered after deforestation led to soil erosion, river siltation, wood shortages and other banes of agricultural and industrial productivity. If the poles continue to warm faster than the tropics, it will certainly affect the prevailing windsystems, ocean currents and rainfall patterns. City planning should conform the changed life style (grainland : 0.178 ha/capita) or else a great strain on our environment would be put on (Pecora, 1969; Sandbach, 1980; Boserup, 1981; Stavrianos, 1983; Warnock, 1987).

With shifts in the balance of power and the resultant redrawing of the world geo-political map, developed the 'energy crisis' and 'the Third World' that rocked the global scenario. The situation is serious no doubt, but it is certainly not desperate yet. With true will, the solutions to our problems must be willingly adopted or they will be violently imposed from outside. If the necessary measures were not taken in time, the Third World would advance to shatter the world's social order in one way or another. At best this would bring about a progressive collapse and decline of the civilization of which we are so proud; at worst, it would provoke a great march northward of the starving and the dawn of the new Middle would bring about a progressive collapse and decline of the civilization of which we are so proud; at Ages (Abler, Adams and Gould, 1971; Commoner, 1972 a; Birch, 1973; Loup, 1983; Friedmann, 1986; Harriss, 1986).

In reality, the natural resources of the ecosphere are being wastefully consumed at an increasing rate under the combined effect of population pressure and the dramatic increase in industrial production. The current rate of the use takes absolutely no account of the real size of available reserves of minerals and fossil fuels, nor does it concern itself with the rate of renewal of plant or animal resources. The needs of future generations are similarly ignored. In addition to that, malnutrition is spreading in the Third World, and in a future that is closer than some people think, the industrialized and overpopulated countries of Europe and other continents will no longer be protected from shortages of animal protein (Smith, 1979; Mcharg, 1969; Detwyler, 1971).

Epilogue

The key resources - energy, minerals and cultivable land - are unevenly distributed; the combination of particular resources in particular nations and regions makes for a complex mosaic. Deficiencies are often remedied through trade. The cause of concern is the present rate of exploitation of natural resources, that resulted in other economic, social and ecological problems : loss of livelihood of local inhabitants, silting of reservoirs, damage to hydro-electric plants and an increase in flash-floods with consequent damage to property, crops and livestock (Sandbach, 1980, Goudie, 1981, Dinham and Hines, 1983). Another cause of concern to humanity is the ideologically different exploitation-based global geo-political economy leading to international tensions, conflicts and war : *till now, thousands of war of varying dimensions have been fought, killing millions of people.*

Science and technology has produced nuclear weapons, that are more sharp, destructive and fatal to human civilization : since 1959 there have occurred several disasters in nuclear reactor stations, leading to the leakage of redioactive materials, spreading radio-active contamination that are certainly carcinogenic and deadly ; the major cause of today's concern is the problem of nuclear waste disposal. Besides, several underground nuclear atomic explosions have been made in the name of scientific experiments, generating serious shockwaves that are certain to have destabilized the Earth's crustal stability (?). Hence, the experts feel that enough has been done at least to partially damage the self-regulatory system of our mother

Earth; she must be given sufficient time to recuperate and restore her own by immediately shunning all such foolish actions.

The set of rapid actions to be taken, now at the dawn of the 21st century / 3rd millenium are :

- It is urgent to put an end to the world's population explosion. Particularly urgent is the need to think at once about reducing the pressure in already overpopulated regions by freely accepted birth control.
- Simultaneous with this, the enormous wastage of renewable resources indulged in so freely by the West's consumer society should be reduced as far as is humanly possible and, at the same time, everything that can be recycled should be recycled.
- An equally urgent, measure is the conservation of the potential biloogical productivity of land, sea and inland waters, and its rehabilitation in those environments where fertility has been thoughtlessly reduced through activities working against nature. It must be accompanied by the preservation of the world's genetic stock of plants and animals, the fruit of hundreds of millions of years of evolution.
- As the humans share the same boat, all fruits of science and technology must be utilized for the human welfare, irrespective of caste, creed, religion, socio-economic make-up and political ideology.

The astronauts, looking at the Earth from the outer space, can realize how infinitesimally small our world is - both our beautiful planet and we ourselves. Jim Lovell, an American astronaut remarked : indeed, there is no end of happiness to live on our planet. It is no end of happiness for people to have such a wonderful, comfortable planet. At times, I feel like exclaiming : People save the Earth! It is so small, fragile, delicate, vulnerable! There is no other planet like it. We all share One Earth with One Common Future. It is the dawn of a new century, a new millenium. Lets build a new mentality, a new attitude to protect and save our boat floating in the limitless Ocean of Universe as per Creator - Xs design.

Live on, the Earth!
And you, Earthfolk, take this into Your Head:
If this one were dead,
Of a thousand planets noe loved on like it
Of a thousand planets none so green and so sweet,
So live on, the Earth!
Live on!

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PEACE WITH NATURE
Long Live The Rich

*DHRUBOJYOTI GHOSH**

The ecological pilgrim's progress from the late sixties when the foundations of the prevailing economic order were threatened — assumptions about nature and natureal resources were being challenged — has been a complex mix of serious scientific debate, political posturing, industrial opportunism, intellectual dishonesty, human exploitations, some clean technology and much global fanfare vis-a-vis great environmental conferences. The most outstanding of them possibly has been the Rio Earth Summit when Gro Harlem Brundtland burst upon the environmental centrestage with her much acclaimed 'Our Common Future' that featured the concept of sustainable development. Extensively welcomed as the official view of the United Nations, Ms Bruntland's definition of sustainability was simple: development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Much academic debate has pursued the definition without really focusing on the most critical question of all times : has the industrial system ever failed to recognise the limits of sustainability? The fundamental questions is "sustainability" form whose perspective : Rich man's? Poor man's? Nature lover's? Between *Paul Shepard* and *Daniel Mckinly's* contention that ecology was a 'Subversive Science' to my understanding of environmental science as an anti-establishment theory, there is the sustainable argument that has carried the day, at least since the last decade of the 20th century. Environment has always been seriously considered, analysed and understood by those who ruled the world. the rich who have indeed comprehensively incorporated in concern for nature into their mainstream developmental strategies and managed to avoid a major prospective crisis for capitalism.

Michael Redclift spoke of two kinds of bias in much of the sustainable development debate. First, a bias towards "managerialism" rather than on resource management, stemming from a top-down approach to local level development. second, a tendency to treat sustainable development as merely a variation of the prevailing Northern, economic-centered world view of development problems. Redclift argued that sustainable development needed to be recognized as an alternative to the prevailing view rather than a modification of it. He defended an approach emphasizing human needs which incorporates an understanding of the political and epistemological dimensions of the concept, as well as the economic ones.

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Jessica M. Vivian, in her attempt to search for the foundations of sustainable development concluded that 'struggles for greater participation are essential elements of the foundations of an endurable basis for sustainable development. This process can only be helped by the growing recognition of the importance of the environment for the future well-being of the entire planet that in turn would mean empowering those critical to the creation of this safer world. The question is how widespread is this empowerment; the control of man over physical and social resources within the development process. The empowerment potential will be determined by efforts of both development agents and environmentalists not only to support people's right for self-determination on the basis of a recognition that their struggles are essential for the health of the environment. Well meaning though, many a self-determination movement in history and in the world today have come to a nought. Dividing the country into an increasing number of states is a part of 21st century "self-determination".

Northern critics of Northern views place things in an interesting prespective, aided by the Southern arguments. Given the cuestionable intellectual honesty and reliability of those peopling this environmentally conscious universe, much of the debate represents a conscious effort by those promoting environmental disorders to create confusion. This is natural because under the regime of private property, unpaid labour has been a major source of wealth. Exploitation of the human resource having been perfected down the ages, deceitfully, under the guise of development. What in essence has been achieved is a regime of 'Sustainable impoverishment'. Lesser mortals, workers who create wealth for the rich, should only be granted such privileges as will barely meet the needs of keeping them in a state of mind and health essential to put in the demanding hours for creating wealth for the owners of their time. For the rich, there is little difference between exploiting nature, natural resources or humans. For them, as for conventional ecologists (especially the "deep ecologists"), humans have no special stature and are objects of exploitation, just as goats, elephants or a coal mine.

The rich quickly began to appreciate the limits of human exploitation through an intelligent assessment of the history of class struggle and, accordingly, perfected their instruments for sustainable impoverishment. As far as nature was concerned, they had no meaningful experience of crossing the limits till the sixties when brilliant ecologists and environmental scientists exposed the mythe of "nature infinite" and realised the need to distance themselves from the position of deep ecologists to whom humans are no more special than other species in the animal kingdom. For them man must not be allowed any special entitlements and any entitlements must be governed by the exigencies of the situation, which indeed had been the accepted position till the human and environmental rights issuse assumed centrestage and threatened the sustainability of the wealth-producers position. The truth, however, is that industrial development has always been sustainable; otherwise industry would not have survived. The parameters of this sustainability has changed with the changing times, because those controlling the levers of power could read the writing on the wall and changed track, tone and tools to deal with the changing business environment; ecology being only a part of it. Industry has survived down the ages even when man did not enjoy preferential status over animals. Even today, impoverished millions die of inadequate sanitation and lack of access to safe drinking water which could be addressed at a cost of $ 6 billion annually. this money is not available but $ 800 billion is available for war, $ 400 billion for narcotics, $100 billion for alcohol and $35 billion for entertainment expenses to settle business deals by the Japanese.

That the global industrial system continues to sustain itself despite this state of affairs is because the employee class has been conditioned to a concept of "virtual rationality" whereby most of us, the beholders, begin to appreciate the rationale behind these such acts of extortion, so much so that we choose to remain indifferent to the loot of the poor by the rich. This has been facilitated by the fact that throughout the present mode of production, there has been a variation in the rate and degree of human exploitation depending on the state of the social mindset. Producers, howsoever ruthless, respected the limits of tolerance determined by the necessities that had to be provided for to maintain the stock of human resources reproductive. This meant ensuring "sustainable impoverishment", while touting it as "sustainable development". One would be mistaken if such development was considered as something that reflected a respect for genuinely sustainable technologies. This is why the Narmada Dam continues to be considered as the only solution to the water problems of the region while the simplest of the pond system options for wastewater treatment and utilization is opposed, tooth and nail, by the builder-engineer lobby. This, despite the advanced understanding of the problem of wastewater treatment that upholds the endegenous technology of ponds and use of nutrients to grow food as the sustainable option. India will take a lot more time to understand that the Narmada Dam or conventional sewage treatment plants are unsustainable options not only for the common people but also unsustainable as generators of wealth and profit for the rich. However, having successfully campaigned for the cause of "sustainable development" as the wealth producers saw it, through every vital international fora like UN, UNEP, World Bank, etc. the wealthy helped themselves overcome a crisis of capitalism. They have given themselves a longer time span to impoverish humans and plunder nature by defining the sustainable limits of exploitation, which itself is the generator of all wealth.

For a long time to come, all of us will most obligingly pursue the agenda for sustainable development. This is not to suggest that environmentalism has no role to play in our life. On the contrary, environmental movements have become more challenging. The additional cost of caring for nature will mainly be exacted from the poorer people of the poorer countries. Enviornmentalism will have an enhanced agenda to thwart the designs of rich countries in their bid to extort the people of the poorer countries through unequal legal regimes, international treaties and dubious logic.

Unfortunately, most ecologists, especially biologist-turned-ecologists, have failed to understand that the impoverishment of the people and plunder of nature are not only the outcome but the prerequisite of the current development process. Exclusively focusing on the plunder of nature and not looking at the impoverishment of the people has rendered their effort largely inconsequential in terms of understanding the roots of exploitation and designing a remedial agenda. What is needed is a kind of ecology that studies the plunder of nature along with the impoverishment of the people. This, I call, welfare ecology.

Given this background, 'sustainable development' assumes a specific meaning: it is a "development process that recognizes the limits of exploitation". Exploitation is fundamental to the process and encompasses exploitation of humans by the humans and exploitation of nature by the humans. All this takes place in a regime in which the rich have, for the world to see, negotiated for peace with nature and drawn up limits to its plunder. This definition of sustainable development may provoke anger in the minds of global industrial leaders, but can hardly be ignored.

THE PROBLEMS AND PROSPECTS OF TOURISM AT DIGHA

MAMATA DESAI[1]
SANGHAMITRA ADHYA[2]

Introduction :

The Digha coastal region of West Bengal is one of the famous beach resorts, located in the East Coast of India. The easy accessibility through a network of National and State highways, scenic beauty, pleasant weather, nearness to Calcutta, have made Digha, the only sea-board urban area and a place of tourist interest in West Bengal.

The Digha coast is an erosion prone region from its very origin. Moreover, the resort was developed without considering any future environmental problems. During the early stages of its development, most part of the township grew right along the coastline. The old Digha is more vulnerable to erosion than the new Digha, because the Old Digha area falls under the 'Zone of erosion', while the New Digha is under the 'zone of accretion'.

Evolution of Digha as a Tourist Resort : Digha has been known as a holiday resort since eighteenth century. The earliest mention of Digha is found in the works of O 'Malley (1911). According to him the Digha was located about 400 m inland of Birkul, an eighteenth century sea resort, developed by the British. Birkul was well-known settlement, situated on the Bengal-Orissa border. Mentions of Digha are also found in the works of Hunter (1876) Valentiyn (1664), Bowrey (1688), Kenell (1788) and Thrillier (1874). But the scope of exploring the natural beauty of the sea-shore was considered effectively by an English businessman of Calcutta; who rediscovered its immense beauty from the existing literatures. During 1911, the Public Works Department had constructed one Inspection Bunglow on one of the dunes, apparently to avoid the erosion problem. In 1956 the Department of Planning and Development, Government of West Bengal had prepared a development scheme to support tourism economic related activities at the hinterland

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of Digha, covering an area of about 0.55 sq. km. The area coverage was further increased by 4.45 sq. km. under the comprehensive Urban Development Plan in 1966. During the period about 33 coastal mouzas were separated from Ramnagar P. S. and were included in the newly formed Digha P. S. Thus Digha was declared as 'Controlled Area, under the C.M.P.A Central Act 1965'. In 1975 about 6.01 sq. km. area of Digha township, was created by covering 3 rural mouzas viz. Dattapur, Gadadharpur and Palsandpur.

Thereafter within the purview of West Bengal Town country Act. 11979, the Department of Development and Planning declared 16 mouzas in Digha P. S., covering an area of about 14.78 sq. km to form Digha township. At the same time the Digha Planning Authority was constituted to control the haphazard and unplanned growth of the town. During subsequent years, the Digha Planning Area was further extended to 37 sq. km. by adding 24 other mouzas from Digha and Ramnagar P.S.

At present Digha township is administered and controlled by the Digha Development Authority. The entire Digha region has been divided into 3 zones by the D.D.A.

They are :

a) The western region comprising Old and New Digha township with rural fringe area.

b) The central region, is a still basin, mainly used for fisheries, and is known as 'Mohana'.

c) The eastern region is entirely a rural area.

The infrastructural facilities available at Digha for the growth of tourism

There are certain available infrastructural facilities, for which the Digha has grown up as a tourist spot.

i. Commercial activities predominate both at the old and New Digha. There is one daily market at Old Digha, other than weekly 'hats' at different villages. The region has no such industry, except some ice factory. So industrial pollution is less.

ii. Digha is well connected by the metalled road to Calcutta. The road passes through Digha to Orissa. Apart from road connections, there are numerous pacca roads connecting the surrounding villages.

III. Underground source is the main source of drinking water supply. There is only one deep tube well, managed by the PHE, with a capacity of 2,73,00 litres overhead storage per day. Other sources are shallow tube wells.

iv. Digha gets its power supply from D.V.C. All the hotels, lodges, offices and residences are well connected by electric lines. But road and beach lightings are not satisfactory. Moreover, the low voltage problem and intermittent power failure are very common.

v. The PHED has prepared a comprehensive master sewarage scheme for Digha, for channelising the waste water through the sea, after being thoroughly treated. Since it would take time to implement the plan, an existing low cost surface drainage system around the foreshore area is now being utilised.

vi. Regarding sanitary facilities, it is found that most of the tourist related establishments have their own sanitary facilities. As these are not sufficient, 'Jhau bans' and sea beaches are often utilised by the day tourists for sanitary purposes.

vii. Digha is provided with only one hospital and a primary health centre which serve the people of Digha and surrounding regions.

The above mentioned all facilities are not adequate in comparison with huge inflow of tourists during season time.

Tourist Accommodation at Digha

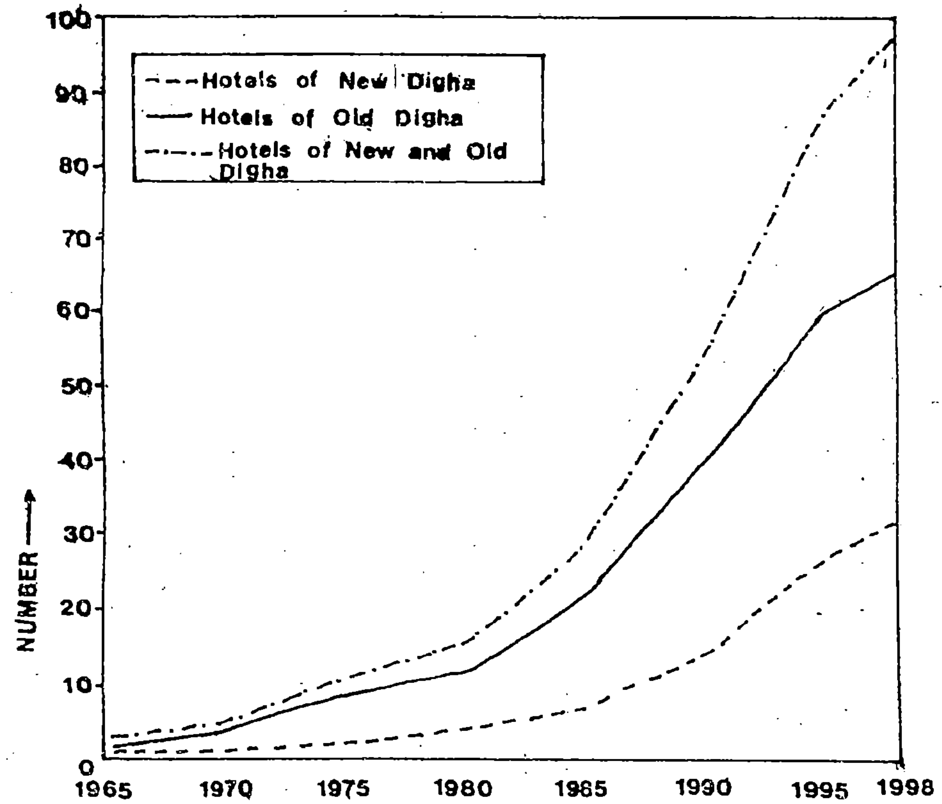
Till mid 80s tourism and related activities were mainly concentrated at Old Digha. Major tourist accommodations including Govt. Guest Houses were developed along the beach of Old Digha especially along the foreshore road, Barrister's Colony and Sivalaya Road. After the opening of Naghat bridge over the River Haldi, the tourist inflow at Digha has increased considerably. At present the accommodation capacity at Digha has increased considerably, and is seventy times in comparison with the capacity of mid seventies. The Table I explains the yearwise growth of hotels and accommodation at Old Digha, New Digha and Shankarpur from 1960s onwards (Fig I)

Table - I

Yearwise Development of Hotels and Holiday Homes at Old/New Digha and Shankarpur

	Purpose Nos.	1960s	1970s	1980s	1990s	N/A	Total
Old Digha	2	8	11	51	43	10	125
New Digha	–	1	3	11	20	–	35
Shankarpur	–	–	–	–	3	1	4

GROWTH IN NUMBER OF HOTELS 1960s—1990s



The Table 2, 3 and 4 explains establishment of Hotels and Holiday Homes at Old Digha, New Digha and Shankarpur which also clearly indicates the gradual emergence of New Digha as an important, focus of development from the mid eighties. (Table 2, 3, 4)

The above Tables explain that there is about 35 Hotels or related establishments at New Digha and 125 at Old Digha with carrying capacity of about 1831 and 6355 respectively. At Shankarpur there are altogether 4 Hotels with a carrying capacity of about 140. Most of the Hotels are organised by New and Old Digha Hotelier's Association. Except these hotels and holiday homes, there are some government organised tourist centres like cottages etc.

In Old/New Digha and Shankarpur number of tourists fluctuate seasonally. During Durga Puja about 80% to 85% of the total carrying capacity is filled up, while during winter and summer holiday above 90% is filledup. In rest of the year, especially in the week days only 5% to 6% is generally filled up.

About 95% of the total hotels are made for middle income group.

Table - I

HOTELS & HOLIDAY HOMES OF OLD DIGHA

SL. No.	NAME OF THE HOTELS	No of rooms	Total Capacity Persons	NO. OF THE VISITORS IN			
				Puja Period (85%)	Winter Period (85%)	Summer Period (90%)	Rest of the year (5–10%)
1	Abakash		16	141	14	14	1 - 2
2	Agamani		12	10	11	11	(less than 2)
3	Anandam Hotel	20	65	55	59	59	3 - 7
4	Annapurna Lodge	20	66	56	59	59	3 - 7
5	Ashok Hotel		26	22	23	23	1 - 3
6	Balaka Lodge	22	105	89	95	95	5 - 11
7	Bansanti Lodge		16	14	14	14	1 - 2
8	Bay View Lodge		40	34	36	36	2 - 4
9	Bina Bhawan		14	12	13	13	(less than 2)
10	Blue View	23	54	46	49	49	3 - 5
11	Chalantika		30	26	27	27	2 - 3
12	Champa Holiday Home		14	12	13	13	(less than 2)
13	Chowdhury Lodge	14	47	40	42	42	2 - 5
14	Classic	14	37	32	33	33	2 - 4
15	Classic Lodge		30	26	27	27	2 - 3
16	Daisy	12	36	31	32	32	2 - 4
17	Deys Holiday Home		4	3	4	4	0 - 4
18	Dhananjay	6	13	11	12	12	(less than 2)
19	Digha Lodge	18	48	41	43	43	2 - 5
20	Ekanta Apan	12	36	31	32	32	2 - 4
21	Gouri Holiday Home		4	3	4	4	(less than 1)
22	Hemangini Lodge	10	32	27	29	29	2 - 3
23	Holiday Home : Grindlays Bank		8	7	7	7	(less than 1)
24	Holiday Home : Hongkong Bank		4	3	4	4	(less than 1)
25	Holiday Home : SBI		6	5	5	5	(less than 1)
26	Holiday Home : UBI		8	7	7	7	(less than 1)
27	Holiday Home : Allahabad Bank		26	22	23	23	1 - 3
28	Holiday Home : B. Co-op. Bank		32	27	29	29	2 - 3

HOTELS & HOLIDAY HOMES OF OLD DIGHA

SL. No.	NAME OF THE HOTELS	No of rooms	Total Capacity Persons	NO. OF THE VISITORS IN			
				Puja Period (85%)	Winter Period (85%)	Summer Period (90%)	Rest of the year (5–10%)
29	Holiday Baranagar Co-op Bank		4	3	4	4	(less than 1)
30	Holiday Home : CESC		16	14	14	14	1 - 2
31	Holiday Gillindes Co-op Soc.		8	7	7	7	(less than 1)
32	Holiday Hara Co-op. Soc.		8	7	7	7	(less than 1)
33	Holiday Home : INDAL		8	7	7	7	(less than 1)
34	Holiday Home : LIC		11	9	10	10	(less than 1)
35	Holiday Home : Ordance Factory		26	22	23	23	1 - 3
36	Holiday Home : State Bank		20	17	18	18	1 - 2
37	Holiday Home : UBI		24	20	22	22	1 - 2
38	Holiday Home : WBSEB		32	27	29	29	2 - 3
39	Hotel Cozy	19	58	49	52	52	3 - 6
40	Hotel Ajanta	37	112	95	101	101	6 - 11
41	Hotel Amit	37	127	108	105	105	6 - 12
42	Hotel Ashirbad	37	127	108	114	114	6 - 13
43	Hotel Bela Nivas		40	34	36	36	2 - 4
44	Hotel Blue Bird	14	42	36	38	38	2 - 4
45	Hotel Dolphine	58	213	181	192	192	11 - 12
46	Hotel Duke	61	210	179	189	189	11 - 12
47	Hotel Hindustan	14	42	36	38	38	2 - 4
48	Hotel Host	64	237	202	213	213	12 - 24
49	Hotel Kaniska	18	47	40	42	42	2 - 5
50	Hotel Kichukshan	24	57	49	51	51	3 - 6
51	Hotel Omega		100	85	90	90	5 - 10
52	Hotel Pushpak	37	113	96	102	102	6 - 11
53	Hotel Ranjan	28	86	73	77	77	4 - 9
54	Hotel Samrat		6	5	5	5	(less than 1)
55	Hotel Samudra Samrat	36	115	98	104	104	6 - 12
56	Hotel Sathi	23	69	59	62	62	4 - 7
57	Hotel Sea Queen	37	127	108	114	114	6 - 13
58	Hotel Sea Gulf		35	30	32	32	2 - 4
59	Hotel Sea View	14	37	32	33	33	2 - 4
60	Hotel Shanti Nivas		60	51	54	54	3 - 6

HOTELS & HOLIDAY HOMES OF OLD DIGHA

SL. No.	NAME OF THE HOTELS	No of rooms	Total Capacity Persons	NO. OF THE VISITORS IN			
				Puja Period (85%)	Winter Period (85%)	Summer Period (90%)	Rest of the year (5–10%)
61	Hotel Shyam Sunder	18	54	46	49	49	3 - 5
62	Hotel Subhasree	24	48	41	43	43	2 - 5
63	Hotel Sun-N-Sea	39	122	104	110	110	6 - 12
64	Hotel Yotsna		32	27	29	29	2 - 3
65	Jalanidhi Lodge	12	36	31	32	32	2 - 4
66	Kasumdia Co-op. B.H.H.		8	7	7	7	(less than 1)
67	Lalkhuthi Lodge		30	26	27	27	2 - 3
68	Ma Tara Lodge		32	27	29	29	2 - 3
69	Neelachal Lodge	15	47	40	42	42	2 - 5
70	Palm Beach Hotel		6	5	5	5	(less than 1)
71	Purbasha Lodge	73	237	202	213	213	12 - 24
72	Sagar Kunya		8	7	7	7	(less than 1)
73	Sagar Lodge	6	17	14	15	15	1 - 2
74	Sagarika Lodge	14	42	36	38	38	2 - 4
75	Saikat Sree	14	47	40	42	42	2 - 5
76	Saikatabas	Ac 40	Ac 88	Ac 75	Ac 79	Ac 79	Ac 4 - 9
		Pr 20	Pr 45	Pr 38	Pr 41	Pr 41	Pr 2 - 5
77	Samara Sohanna Lodge		60	51	54	54	3 - 6
78	Samudra Raja	24	55	47	50	50	3 - 6
79	Samudra Villa	14	37	32	33	33	2 - 4
80	Sandhya Deep Lodge	22	66	56	59	59	3 - 7
81	Satyabhanu	14	37	32	33	33	2 - 4
82	Satyamaya		36	31	32	32	2 - 4
83	Sea Hawk	60	180	153	162	162	9 - 18
84	Sea Bird	36	121	103	109	109	6 - 12
85	Sea Coast	37	125	106	113	113	6-13
86	Sea-Weed		32	27	29	29	2 - 3
87	Shantinibas	37	125	106	113	113	6 - 13
88	Shriramkuthi Lodge		30	26	27	27	2 - 3
89	Sindhu Nibas	10	28	24	25	25	1 - 3
90	Sonali Lodge	18	54	46	49	49	3 - 5
91	State Fisheries Dev. Bank		31	26	28	28	2 - 3
92	The Waves	8	24	20	22	22	1 - 2
93	Tourist Lodge WBTDC		56	48	50	50	3 - 6

HOTELS & HOLIDAY HOMES OF OLD DIGHA

SL. No.	NAME OF THE HOTELS	No of rooms	Total Capacity Persons	NO. OF THE VISITORS IN			
				Puja Period (85%)	Winter Period (85%)	Summer Period (90%)	Rest of the year (5–10%)
94	Uma Lodge		24	20	22	22	1 - 2
95	Vivekananda Nivas	17	57	49	51	51	3 - 6
96	Belaniwas	37	105	89	95	95	5 - 11
97	Hotel Amber		31	26	28	28	2 - 3
98	The Sagarika Lodge	8	24	20	22	22	1 - 2
99	Basabadotta	10	30	26	27	27	2 - 3
100	Hotel Sarada	24	57	49	51	51	3 - 6
101	Oceania	12	36	31	32	32	2 - 4
102	Sudhity Lodge	5	15	13	14	14	1 - 2
103	New Saha Lodge	14	39	33	35	35	2 - 4
104	Amantran	14	51	43	46	46	3 - 5
105	Janhabi Bhavan	10	30	26	27	27	2 - 3
106	Shivankuthi	14	47	40	42	42	2 - 5
107	Big-Eater Hotel	–	–	–	–	–	–
108	Kanyakumari	13	37	32	34	34	2 - 4
109	Rai Lodge	24	75	64	68	68	4 - 8
110	Hotel Nandan	15	45	38	41	41	2 - 5
111	Sananda Lodge	5	27	23	24	24	1 - 3
112	Manjushri Lodge	8	24	20	22	22	1 - 2
113	Suryaman Hotel	9	27	23	24	24	1 - 3
114	Niloy Lodge	6	18	15	16	16	1 - 2
115	Mahua Lodge	10	30	26	27	27	2 - 3
116	Madhuban Lodge	18	60	51	54	54	3 - 6
117	Dreamland	14	47	40	42	42	2 - 5
118	Krishna Lodge	8	24	20	22	22	1 - 2
119	The Retreat	3	27	23	24	24	1 - 3
120	Sangrita Resorts	6	24	20	22	22	1 - 2
121	Bina Lodge	11	33	28	30	30	2 - 3
122	Sirdhi Lodge	5	15	13	14	14	1 - 2
123	New Anjali Niwas	5	25	21	23	23	1 - 3
124	Larika Holiday Inn	70	225	191	203	203	11 - 23
125	Gouri Lodge	10	25	21	23	23	1 - 3
126	Chalantika - B	5	15	13	14	14	1 - 2
	TOTAL	**6336**					

Table - 2

HOTELS & HOLIDAY HOMES OF NEW DIGHA

SL. No.	NAME OF THE HOTELS	No of rooms	Total Capacity Persons	NO. OF THE VISITORS IN			
				Puja Period (85%)	Winter Period (85%)	Summer Period (90%)	Rest of the year (5–10%)
1	Cottages		70	60	63	63	6 - 7
2	Gul Mohar		20	17	18	18	1 - 2
3	Durga Bhavan		33	28	30	30	2 - 3
4	Holiday Home	9	30	26	27	27	2- 3
5	Holiday Home : DVC		29	25	26	26	2 - 3
6	Holiday Home : HMV		12	10	11	11	(less than 1)
7	Holiday Home : Police		56	48	50	50	3 - 6
8	Holiday Home : Private		21	18	19	19	1 - 2
9	Holiday Home : Sagari		26	22	23	23	1 - 3
10	Holiday Home : Santiniketan		20	17	18	18	1 - 2
11	Hotel Asha		29	25	26	26	2 - 3
12	Totel Athithi		10	8	9	9	(less than 1)
13	Hotel Casurina		115	98	104	104	6 - 12
14	Hotel Daffodil		60	51	54	54	3 - 6
15	Hotel Gitanjali		55	47	50	50	3 - 6
16	Hotel Manasi	15	50	43	45	45	3 - 5
17	Hotel Manaskanya	11	27	23	24	24	1 - 3
18	Hotel Marina	28	85	72	77	77	4 - 9
19	Hotel Swadesh	10	45	38	41	41	2 - 5
20	Hotel Sarena (Serina)	28	85	72	77	77	4 - 9
21	Hotel South End	35	125	106	113	113	6 - 13
22	Hotel Sujnny	21	65	55	59	59	3 - 7
23	Malancha		44	37	40	40	2 - 4
24	Manaka Nibas		20	17	18	18	1 - 2
25	Ocean View	11	30	26	27	27	2 - 3
26	Peneti Bhawan		40	34	36	36	2 - 4
27	Priyadarshini		52	44	47	47	3 - 5
28	Taj Mahal		28	24	25	25	1 - 3
29	Taranga Nire		16	14	14	14	1 - 2
30	Youth Hostel		98	83	88	88	5 - 10
31	Hotel Sea Voyage	33	100	85	90	90	5 - 10

HOTELS & HOLIDAY HOMES OF NEW DIGHA

SL. No.	NAME OF THE HOTELS	No of rooms	Total Capacity Persons	NO. OF THE VISITORS IN			
				Puja Period (85%)	Winter Period (85%)	Summer Period (90%)	Rest of the year (5–10%)
32	Hotel Mallika	33	100	85	90	90	5 - 10
33	Hotel Amrita	30	100	85	90	90	5 - 10
34	Hotel Suman's	21	50	43	45	45	3 - 5
35	Hotel Gitanjali (Annexe)	30	85	72	77	77	4 - 9
	TOTAL		**1831**				

Table - 3

HOTELS & HOLIDAY HOMES OF SHANKARPUR

Sl. No.	Name of the Hotels	No. of Rooms	Capacity in person	No. of Visitors			
				Puja	Winter	Summer	Rest of the year
1	Ashoka Hotel & Lodge	19	40	24	40	–	2 - 4
2	Sandy Bay	19	38-40	28	40	12	2 - 4
3	Saikat Sri	13	40	24	28-40	12	2 - 4
4	Hotel Joar		20	–	–	–	–

Table - 4

Income wise Distribution of Tourist Traffic at Digha

Sl No.	Type of tourist according to monthly income	% total tourist traffic
1	Middle income group (lower and upper up to Rs. 10,000	80
2	Higher middle income group (Rs. 10,000 - 15,000)	15
3	Higher income or elite group (Rs. 15,000 and above)	5

Problems and Prospects

As is said earlier, that Digha is a very popular resort especially to the middle and lower middle income group in spite of some of its negative points. During some peak tourist seasons, especially during christmas and English New Year Eves, some studies were made, the results of which are given below.

Inadequate tourist accommodation : Since 1980s tourist accommodation at Digha has increased considerably, but at the same time number of tourist inflow has increased more than proportionately. Moreover there is no such system that day tourists can accommodate themselves. The development of any tourist resort is largely dependent on its infrastructural facilities. Among which well developed transport net work is most important. At present State Highway 4 is the only effective regional link. As a result, journey to Digha, especially during tourist season is neither comfortable nor speedy. Mentioned should be made in this context that the Digha-Tamluk Railway link is under construction. It is expected after completion of which, there would be sure improvement in the transport network.

Coastal Erosion : Coastal erosion in the form of beach erosion is a major problem that are faced by the tourist specially in Old Digha. Although different measures have been taken to reduce the extent of erosion, yet as because it is a critical natural phenomenon, tourists generally avoid beach from Old Digha up to Mohana.

Frequent natural hazards : It is another drawback for proper development of Digha. As this coastal belt is situated within the cyclone prone zone, natural hazards in the form of cyclones are very common during pre and post monsoon period. Sometimes due to severe cyclones, road links are disconnected, as in the case of 16th October 1995, when coastal areas of Medinipur district were struck by high tidal surge, and parts of Digha township was completely ravaged by floodwater for several days. A large portion of check wall in Old Digha was destroyed. The long sea-wall, paved by cementing rectangular lateric and charnockite boulders were crumbled due to heavy pressure of surging waves. Again during 20th August 1997, a high velocity cyclone had struck the Digha coastal area, when tidal waves rose up to 5.6 mt. height; and damaged the coastal structures. In Old Digha from the bathing Ghat no. 2 to Mohana, the seawall was destroyed. Even the light posts were tilted. A major portion of the sea wall adjacent to Hotel Sea Hawk was damaged due to scouring by high tidal surge.

In October, 1999, the lowland near Jatra nala was inundated by high tidal surge, completely damaging the foreshore road. Near Digha Mohana steep dune face has been damaged, and has become vulnerable for further erosion.

One serious event, which has been noticed, that during any cyclonic storms along with high tidal surge, the granitic and latertic boulders (which are being used for check wall purposes) are tossed up by surge water, and are found lying scattered all over the beach. This situation is particularly very dangerous in respect of tourism. Because at Digha, the resort has developed entirely depending on the 5.5 km. sea-beach, and except sea beach, there is no such important tourist attraction or recreational facilities at Digha.

Table - 5

Average Evaluation of Erosion Damage

Immediate effects (frequently damaging nature)	Area Affected
1. Loss of beach sediments	Near Mohana and Shankarpur
2. Recession of dune, bluffs and cliffs	Ghat No. 1, and 2, Digha Mohana
3. Weakening and destruction of sea wall	Ghat No. 1, and 2 below Sea Hawk Hotel
4. Inundation and loss of agricultural land	Atili, Gangadharpur, Gadadharpur Mouzas.
5. Loss of income from beach recreation	In Old Digha beach mainly
6. Saline water intrusion	In some PHED wells and agricultural fields

Source : Based on field studies.

Lack of proper drainage and sewerage facilities is another constraint for the proper development of tourism at Digha. At present, there is no such organised or scientific solid waste management or waste water disposal system under DDA. It is a very common picture that the sewerage water is being discharged directly into the sea through sea-beach without any tunneling system. This not only pollutes sea beach but sometimes pollutes sea water even. Moreover, there are numerous fast food shops found along the beach. Shop owners along with tourists throw all the garbages into the sea water. Plastic cups and plates are found lying all over the beach; which is also dangerous in respect of sea-bio-diversity conservation.

Despite all these drawbacks, thousands of tourists visit Digha in different seasons. Recently D. D. A. has taken up a major project, to treat the waste water and solid waste to manage the 'Jhau' forests along the beach, to keep clean the beach. Hopefully, it is expected that after completion of the project, the urban economic problems of the region would be minimised and the prospect of tourism of Digha coastal area would increase.

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THE TRIBES OF ANDAMANS : Their Struggle For Existence

*MANIS KUMAR RAHA**

INDIA that is Bharat, is a big country with tremendous diversities. This vast tract of land mass has embraced many unique features in different spheres and in different areas. In the north, north-west and in the north-east the Great Himalayan mountain ranges are found to raise snow-clad peaks to touch the boundless sky. Here in these mountainous areas there are places where people live under the cover of snow at least for five to seven months a year. On the other hand, in the western part of this country a great desert is found where people do not get rain even every year. The Indo-Gangetic plains and also the Decan plateau area drained by a large number of rivers, many of which are perennial. Thick forest is found in many places which have not only given shelter to a large varieties of wild animals, birds and insects, but also created balance in the eco-system. Again both coastal areas and islands in the Bay of Bengal and Arabian sea have increased the diversities of this country. In this great country people with different racial stock and different ethnicities - the Mongoloid, the Indo-European, the Dravidian, the Australoid and even the Nigroid, all are found to reside, one by the side of the other. They speak different dialects and have embraced different culture and social systems. They have varied economic pursuits, from hunting-gathering to highly skilled professions. They have faith in different religions and are inclined towards different idealism and world view (Raha 1999).

India has a total population of 838,988 according to 1991 census. Every decade witnesses a significant increase of population. Every moment it is increasing. Most probably all castes, sects, religious groups, tribes and others are also increasing in number except a very few indigenous tribal groups. Even in this modern world when modern men are getting many life saving items to raise their span of longivity, some unfortunate people of our country are marching speedily towards the black hole of death.

Through this article a discussion has been made to highlight the negetive growth of population, rather, rapid decline of population of the tribal people of Andaman Islands and the factors responsible for this rapid decline of the four nigrito population of Andaman Islands, namely, the Great Andamanese, Onge, Jarawa and the Sentinalese, particularly the former two, who are on the verge of extinction.

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The Andaman and Nicobar group of islands, also known as the Bay Islands, form a very small part of India. Situated in the Bay of Bengal Port Blair, the state capital of the Andaman and Nicobar Islands is 1255 km from Kolkata and 1190 km from Chennai. These islands form a conglumeration of over 300 big and small islands. Covering an area of 8249 sq. km. these islands have given shelter to 280,661 human beings of which 154,369 are males and 126,292 females according to 1991 census. Of these population 241,453 live in Andaman group of islands and 39,208 in Nicobar group of islands. These population live in 36 inhabited islands of which 24 are in Andaman group of islands and 12 in Nicobar group. There are 204 revenue villages of which majority are in Andaman group of islands.

Like all States and Union Territories of India, the Andaman and Nicobar islands also invited modernization. Some kind of development for the 'modern' people started in the Andamans with the British occupation of these islands. These development processes continued and further implemented more vigourously after the first quarter of this century. No doubt marked development can be reflected in the present day Bay Islands but the Environmental Service Group of the World Wildlife Fund in India marked in 1985 that 'The islands which were already suffering from the after-effects of colonial exploitation started in 1930s, are today faced with serious ecological destruction from such shortsighted plans for 'development'. The said study group also felt that 'the greatest single environmental threat to the Andaman and Nicobar islands is the destruction of their forest for development'. Both Saldanha (1987) and Whitaker (1985) also cautioned against the wanton destruction of forests in these islands in the name of development and thereby disbalancing the environment of the whole area. Whitaker in (1985 estimated that between 1869 and 1984 a total of 232,000 hectares of forest had been cleared in the Andamans. This destruction of the virgin forest has definite impact on the life and activities of the indigenous people of the islands.

In the Andaman and Nicobar Islands there are six tribal groups. These are the Great Andamanese, Onge, Jarawa, Sentinalese, Shompen and the Nicobarese. Of these tribal groups the formar four live in Andaman Islands and the last two groups i.e. the Nicobarese and the Shompen inhabit Nicobar Islands. The combined population strength of these tribes are 26,770 according to 1991 census forming 9.54% of the total population of the islands and 0.04% of the total Scheduled Tribe population of India. Almost all these population live in the rural areas except 502 (1.88%) person who are urban dwellers. The sex ratio of the tribal population is 947 females per 1000 males while the same for the general population of Andaman and Nicobar Islands is only 818 females per 1000 males. Though the literacy rate among the Scheduled Tribe population is quite high (56.62%) still the same is much less than that of the general population of the islands (73.02%), according to 1991 census. The literacy rate among the Scheduled Tribe males is 61.46% and that of females 48.94%. In this connection it is worthwhile to mention that whatever literacy exists among the Scheduled Tribes of Andaman and Nicobar islands, it is found mostly among the Nicobarese. The other five tribal groups are almost illiterate. Further among the Scheduled Tribes the work participation rate is only 39.15% but it is higher than that of the general population of the islands (35.24%). The strength of the total workers among the Scheduled Tribes of the islands is 39.15% of which the strength of the main workers is 29.92% and that of merginal workers is 9.23%. That means majority of the Scheduled Tribe population of the Bay Islands (60.85%) are non-workers i.e. dependants. Again of the total Scheduled Tribe workers 21.07% are engaged in primary sector, 58.43% in the secondary sector and 20.50% in tertiary sector according to 1991 census. In this connection it is worthwhile to mention here that the census figures relate to the Great Andamanese, Onge and the Nicobarese. The other tribes (i.e. the Jarawa, Sentinalese and the Shompen could not be enumerated).

The four tribal groups namely the Great Andamanese, the Onge, the Jarawa and the Sentinalese, are found to inhabit in different parts of Andaman islands. At present the Great Andamanese are found to stay in the Strait Island where they were settled by the Andaman Administration in 1970 (Sarkar 1993). Prior to 1970 the Great Andamanese were found to live in and around Port Blair, Baratang and Long Island (Kochar 1969; Sarkar 1993), Earlier this tribe was divided into ten groups, namely, AkaChari, AkaJeru, AkaBea, AkaKora, AkaBo, AkaKede, AkaKoi, AkaJuwoi, Aka-eBele and Aka-Pucikwar (Danda 1993, Sarkar 1993). At present only the former three groups are surviving.

The Onge at present live in two settlements, Dugong Creek and South Bay in Little Andaman. When the Onge first came to be known to the outside world they were also found to operate from Jackson Creek.

The Jarawa are found to inhabit in some areas of South Andaman and Middle Andaman particularly in the west coast region. Very little is known about the life style of this tribe. The world Jarawa has been derived from an 'Aka-Bea' word meaning 'stranger'.

The Sentinalese are restricted to North Sentinel Island. They derived their name from the island they inhabit. Their original name is not known. Almost nothing is known about the life and activities of this people..

All the four tribal groups are hunters and gatherers. They mostly depend on hunting, fishing and collection of forest produces. For last three decades or so, the Andaman Administration has come forward with a number of schemes for the welfare of these tribal people particularly for the Great Andamanese and the Onge. The other two tribal groups, the Jarawa and the Sentinalese are yet to become fully friendly with the modern people/outsiders. Efforts are continuing to establish friendly relation with these two groups by giving them presentation articles on which they have fancy. Every full moon day teams consisting of the members of Anthropological Survey of India and the Andaman Administration visit Middle Andaman area for the Jarawa and North Sentinel Island for the Sentinalese and offer presentations and food like coconut, banana etc. in order to win their confidence and friendship.

The above four tribal groups are mostly illiterate. While the Great Andamanese and the Onge have close interaction and friendly relation with the outsiders, the Jarawa and the Sentinalese love to live in isolation and try to avoid contact with the outside world, though a section of the Jarawa has recently developed good relation with the members of the official contact party.

According to 1981 census (1991 Census figures are not available) the total population of the four tribal groups of Andaman islands are the Great Andamanese 27, Onge 97, Jarawa 200 (estimated) and the Sentinalese 100 (estimated) (Table-I). In 1901 the population of these tribes are 625, 572 (estimated), 468 (estimated) and 117 (estimated) respectively.

Table - I

Tribe-wise population in Andaman Islands during different Census years.

Tribes	1858	1867	1901	1911	1921	1931	1941	1951	1961	1971	1981
Great Andamanese	4800	3000	625	455	209	90	–	23	19	24	27
Onges	–	–	572*	631*	346*	250	–	150*	129	112	97
Jarawas	–	–	468*	114*	114*	70*	–	50*	500*	275*	200*
Sentinalese	–	–	117*	117*	117*	50*	–	–	50*	82*	100*

* Estimated Population figure. Source : Sarkar 1993; Whitekar 1985

This means the population strength of these tribes has significantly been declined during the period of 80 years (1901 to 1981). In case of the Great Andamanese the population which was 4800 in 1858 has been alarmingly decreased to 625 in 1901 and thereafter it reached only 19 in 1961. Of course, they later on increased to 24 in 1971 and finally 27 in 1981. On the other hand, the estimated population of the Onge was 572 according to 1901 census. Their population was increased to 631 as estimated in 1911. But thereafter they started decreasing in number steadily and finally reached to 97 only in 1981. The fate of the other two tribes, the Jarawa and the Sentinalese, was no different. The estimated population of the Jarawa was 468 in 1901. Their population has steadily been declined in different decades till it reached 50 in 1951. But suddenly the estimated figure was increased to 500 in 1961 then again dropped to 200 in 1981. A recent estimation shows that there are 530 Jarawas of which 225 are males and 305 females (Naidu 1999). The Sentinalese were estimated to be 117 in 1901. This figure remained constant till 1921. Thereafter it started declining. Their population as estimated in 1931 was only 50. The same figure was reported in 1961 also. But the estimated population figures of this tribe was shown higher in number in 1971 (82) and 1981 (100).

It is thus clear that after the British occupation of these islands, the population of the Andaman tribal groups particularly the Onge and the Great Andamanese has alarmingly been reduced. This reduction of the population size of these tribal groups was far rapid before 1901. An example of the Great Andamanese population will give a clear idea about the miserable fate of these poor people. In 1858 when the British Government first stepped in these islands, the total population of the Great Andamanese was 4800 (Whitaker 1985) which came to be mere 625 in 1901.

The scholars and academicians who undertook research work among these people, came out with a number of factors responsible for the marked decline of the population of the Andaman tribes. Below we will discuss in brief some of these factors.

Populations pressure in the Bay Islands is one of the important factors responsible, directly or indirectly for the miserable condition of the tribal people. In 1901 the total population of Andaman Islands was 18,138 which reached as high as 241,453 in 1991.

Table - 2

Population of A & N Islands Since 1901 (in No.)

Census year	Andaman	Nicobar	Total	Percentage of decadal variation
1901	18138 (66% Convicts)	6511	24649	-
1911	17641	8818	26459	(+) 7.34

Census year	Andaman	Nicobar	Total	Percentage of decadal variation
1921	17814 (66% Convicts)	9272	27086	(+) 2.37
1931	19223 (66% Convicts)	10240	29463	(+) 8.78
1941	21316	12452	33768	(+) 1461
1951	18962	12009	30971	(–) 8.28
1961	48985	14563	63548	(+) 105.19
1971	93468	21665	115133	(+) 81.17
1981	158287	30454	188741	(+) 63.93
1991	241453	39208	280611	(+) 48.70

Source : (1) Basic Statistics, 1995 (II),
Statistical Bureau
Andaman & Nicobar Administration, Whitekar 1985

The increase of population in different decades from 1901 to 1941 was below 10%. This population lost a minor strength from 1941 to 1951 (—8.28%). But from 1951 onward the population rose significantly due to the settlement of a large number of the Bengalee refugees and also because of the influx of the people from different areas of India, particularly from the southern states. According to 1991 census Little Andaman where 97 Onges live, has a population of 12,247. In Middle Andaman 44,901 people and in the Ferrargunj Tehsil of South Andaman 39277 people live. And in these areas about 200 Jarawa live. This definitely has exerted tremendous pressure on the very limited habitable land and forest resources of the islands and would further reduce the forest resources so far enjoyed by the tribal people (Sarkar 1993). With the heavy influx and growth of populations the encroachment in the forest and the rate of illegal felling of trees increased. Firstly the increase of the habitable land by clearing forest and thereafter, illegally clearing of forest by the later immigrants, have drastically reduced the natural resources of the tribal people, thereby creating marked reduction in the surplus of food of these people. The situation will further deteriorate with the rapid increase of the population of these islands in future.

For their hostility towards outsiders, some of the tribal people had to pay a very heavy dividend. Because of their hostility a large number of the Great Andamanese died during the earlier part of the British occupation of the islands. In the Battle of Aberdeen in May 1859 a large number of these people laid down their life against the British bullets. The Jarawa and the Sentinalese even today do not like to interact with the outsiders and to become friendly. No doubt the Sentinalese live in isolated North Sentinel island and do not face frequent encroachment of the outsiders. But the Jarawa are experiencing the same every day as a large number of people live in close neighbourhood. Many Jarawa are killed by the local settlers (Poachers) (Naidu 1999). No doubt a conflict has been developed between the Jarawa and the settlers for various reasons and this has caused great harm to the Jarawas. Between 1946 and 1961 there were 76 encounters with the Jarawa in which 15 settlers and 'many' Jarawa were killed' (Census 1961) (Whitekar 1985).

The construction of the Andaman Trunk Road connecting South Andaman to Middle and North Andaman has thrown another crucial problem as this road has passed through the Jarawa country. For construction of this road a large number of labourers had to be brought. "The entry of a large number of people from outside also led to an increase incidence of poaching in the area. Thus, almost from the very beginning of the second penal settlement, the Jarawa were hardly allowed to remain undisturbed in their own country. They were under constant threat of losing their own territory because of the several measures taken by the British Authorities during the penal settlement and the present national government in implementing development projects. Under such circumstances, they had two alternative : either to surrender to the larger society or to continue to strive ferociously to maintain their independent existence" (Sarkar 1990). The Jarawa have selected what was obvious for them.

The Great Andamanese came in contact with the outsiders for the first time in 1858 and the Onge in 1886. It may be that for their earlier contact the rate of decline of the Great Andamanese is quicker and higher in comparison to the Onge. And another reason is that the British Government established Penal Settlement near the habitat of the Great Andamanese whereas the Onges used to live in the comparatively isolated Little Andaman. So the Great Andamanese were more affected by the outsiders. According to Malhotra & Awaradi (1981) their low resistance power against the diseases introduced by the members of the Penal Settlement and also by the outsiders is an important reason for the decline of the Great Andamanese population. Syphilis and other diseases which affected them while they stayed in the Andaman Home established by the colonial rulers in 1864 snatched a good number of their lives (Mann 1976; Mathur 1968). In 1968 Bronchio - pulmonary infection took an epidemic form and victimised many precious lives of the tribal people (Mann 1976). Sterility among the Great Andamanese which is a cause for their declining population, is because of the syphilis. But this disease may not have affected the Onge as medical examination of the 50% of the Onge did not show the presence of this disease (cf Whitaker 1985). Verma (1976) also believes that the introduction of the veneral diseases to a small population will definitely have adverse affect. An epidemic of measles in 1877 introduced by a batch of convicts also took a good number of lives of the Great Andamanese (Radcliffe - Brown 1964). Kumar (1992) after undertaking immunogenetic study on the Onge population stresses that the high incidence of Hepatitis B surface antigen, or HBsAg (originally named Australia antigen or Au) positive carriers 'in Onge population posses a great health hazard'. The high rate of infant mortality among the Onge may also be considered as a factor responsible for the decline of population (Swaminathan et al 1971). Jain (1981) also observed high infant mortality among the Onge which he considers as the major reason of the Onge depopulation. Similarly Agarwal (1967) also found many barren women and high infant mortality among them. Malhotra & Awaradi (1981) believe that different diseases and the addiction to opium, liquor, tobacco etc. led to the lowering of birth-rate, and high rate of abortion, miscarriage and infant mortality among these tribal people. Use of tobacco may also have adverse affect on their health and sexual appetite (Awaradi 1978). The other reason for their population reduction is the incompatibility of marriageable age between husband and wife (Coomar & Raha 1989). The main reason for incompatibility of marriage age is due to non-availability of suitable marriageable spouses (Awaradi 1978). It may further be highlighted that supply of limited food may be one of the reasons for the decline of their population. This is because of the drastic reduction of forest and other natural resources. The introduction of new food items during the post independence period may also have damaged their health (Malhotra & Awaradi 1981). Cipriani (1966) mentions that the Onge women rarely become pregnant before 28 years of age. This delayed pregnancy may be due to the general biological condition fostered by vagina acidity content or it may be due to the use of *naquineghe* or grass tussel to cover genital organ which reduces the chances of fecundation (cf Mann 1976).

There may be some more reasons which led to the rapid decline of the indigenous tribal population of Andaman Islands. Whatsoever may be the reason(s), the fact is that these tribal people are rapidly moving towards the gate of death. No doubt "what their own environment - ethnic, social and physical - could not do, ours, the advanced men's new imposed environment could do that. Much greater damage was done to these helpless peaceful souls by the modern men's will to reign over them "(Coomar & Raha 1989). No doubt the contribution of the modern men to depopulate these tribes is unmistakably great. For the "blessings" of the modern men "they have come down from their glorious past to the unfortunate present"

(Coomar & Raha 1989). It will be too late if proper action is not taken right now to save them. Any delay in this regard may force them to follow the path of the Yahgan of Chili or the Tasmanians of Tasmania, not a single member of whom is left on the beautiful earth to see the light of the day.

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DARJEELING LANDSLIDES — A GEOPLANNING EXERCISE THROUGH GEOGRAPHICAL INFORMATION SYSTEM FOR FUTURE DEVELOPMENT

*TAPAS GHATAK**

Introduction

Landslides of Darjeeling, though quite frequent and common during monsoon months, it cannot be treated in isolation. It would be difficult for any planner to identify landslides of Darjeeling whether it is an effect of urbanization or a natural disaster. As we are all aware, the growth of urban population in India in last few decades is phenomenally high and Darjeeling obviously was not an exception (Table-1)

Tabel - 1

Percentage Growth of Population (1990 - 91)

Decade	Darjeeling Division	Kalimpong Division	Kurseong Division	Hill areas of Darjeeling
1901-11	11.55	19.29	-8.91	7.31
1911-21	2.84	21.35	-2.06	7.71
1921-31	11.80	13.50	23.34	17.88
1931-41	23.62	15.89	15.37	18.29
1941-51	15.14	18.22	9.55	14.30
1951-61	19.98	28.98	22.87	17.89
1961-71	20.48	11.62	14.14	18.75
1971-81	12.87	20.17	8.67	13.90
1981-91	14.12	21.89	9.87	15.29

Source : Census Head Book of Darjeeling District, 1981 and Forest Directorate, Govt. of West Bengal, 1994.

With the increasing urbanisation in restricted(?) areas of Darjeeling Districts, having minimum infrastructural urban facilities, problems grew up silently. Lack of controlled drainage, proper building rules in the Municipal areas, absence of a perfect zone map of geologically weaker areas within the urbanised sector, added with increasing commercial activity in different sectors of life, the carrying capacity of Darjeeling District, was under "Near collapse" stage. The natural phenomena like cloud burst, heavy rainfall, floods, etc. therefore could leave their impact in a more permanent way as against it used to happen earlier. In spite of all attempts from the Government with definite financial impact on its exchequer, the landslides continued years after years, affecting the life of the people in the hills, during every rainy season. This has also affected the communities from carrying out their regular as well as other related activities during the peak commercial seasons. It may be wise to mention that different Government and Academic agencies were carrying out immense work in this field as research activities, but few have actually reached the level of planning and fewer have reached to the level of execution. Therefore, the present tasks become more difficult where not only it is required to assimilate the relevant more information available from different section, but also to put them into a meaningful format, so that a clear policy can be framed for an effective execution. This chapter will mainly deal with the areas prone to natural disaster in Darjeeling District.

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Physical Eco System

Darjeeling region is unique from environmental Eco perception. In this region there are mighty Kanchandzonga to areas as low as 100 Mts. above sea level. There is a conveyance of different climatic zone with their distinctive attribute. Besides the Tiger and the Elephant there are many rare animals which are endemic to the regions. The Darjeeling Himalayas covering about 3000 sq. km. has been broadly divided into three belts from south to north. 1) The bouldery terraced landscape in the outer foothill belt. 2) The rising hills of the Lesser Himalayan belt comprising autochthonous Siwalik rocks and para-autochthonous Gondwana-Buxa and Daling groups of rocks and 3) the inner mountain belt comprising higher order schists and geneisses of the Darjeeling Gneiss group. The three belts have been dissected by the southerly flowing Tista River into western sector, (the Darjeeling hill) and the eastern sector (the Kalimpong hill).

The area under consideration is restricted within the Lesser and Sub-Himalayan belt of Eastern Himalayan lying between Sikkim toward north, Bhutan toward east and Nepal toward west. The southern foothill region is characterised by East-West extending highly dissected platform of terrace deposits and the inner belt by a well defined ridge line, extending between the Darjeeling hill to the west and Kalimpong hill to the east, overlooking the southerly flowing Tista valley in between, The northern slope of the Darjeeling hilll is dissected by the prominent north easterly flowing rivults contributing to the Ramman-Rangit basin, flowing from west to east into the Tista basin. The south-southeasterly flowing rivulet contributing to the Balsan Mahanadi basin dissects the southern slope of the Darjeeling hill. The Kalimpong hill is rather rugged, with radially descending gullies and streams contributing to the Tista and Jaldhaka basin. Soils have developed in the area and are quite often red in colours, occassionally dark soils are also found. The relative roles of bedrock, as well as present and past climate in development of the soil profiles will be a very interesting study. Due to its geographical location, the area faces a sweeping blast of the southwesterly monsoon directly from the Bay of Bengal through an alluvial gap between the Rajmahal hill in Bihar and the Shilling Plateau in Assam. This result in intensive rainfall and coludbursts.

Geology

The southerly flowing major rivers have exposed a full cross section of different tectonic units extending east west and having distinct stratigraphy, metamorphism and structure. The tectonic units are found to be in the reverse order of straitgraphic superposition after Mallet (1875), Auden (1935), Heim & Ganser (1939), represented by the Siwalik in the south followed by the thrusted sheets of Gondwana, Buxa, Daling, and the Crystalline group of rocks towards the inner Himalayan. The contact between each group of rocks is represented by thrusts, dipping at high angles towards northerly direction. The thrust sheets are considered to be refolded into an East-West trending structure with northerly pitching axial culmination along the Tista Valley. The crystalline group has been considered to be a product of metamorphism with increasing grade from the foothill belt to the inner core, with a band of mylontic gneiss occurring at the sole of the crystalline sheet. (B Chatterjee, 1982).

Evaluation of Landslides Factors

Occurrence incidence

The most important geomorphologic character considered in landslides hazards zones is the presence or absence of formal landslides, as these evidence are the best guide to future behaviour of the slope and a clue to the processes involved. As the regional geology has a direct bearing on landslide or landslides, their causes vary from one locality to another, heavy monsoon precipitation is however a very common cause of these disaster.

Few of the historic landslides which was catastrophic to the Darjeeling District were that of 24th Sept, 1899, which occurred on the eastern side of Darjeeling town and was of quite violent type and confined to soil cap covering the gneisses that form the Darjeeling Ridge. As many as 72 lives were lost and damage to properties was extensive. After this major disaster, the Govt. of West Bengal appointed a committee to enquire into the causes of the landslides and suggested some preventive measures. The committee was of the view that instability of a hill side gradually increased due to progressive absorption of moisture and cutting of hall slopes for both natural and artificial needs, which increased this instability. Defective drainage was also considered as a matter of fact in absorption of moisture and finally led to such catastrophe.

There was another major landslide in Darjeeling Town in 1950, due to mainly excessive rain. Shri J. B. Auden one of the Investigation Geologist stated that "Although capped by soil, the hills slope around Darjeeling are too steep to be saved, against stormy weather similar to those of 1899 and 1950. But according to him, fresh solid insitu rock of the Jalapahar bridge is fairly safe for future construction. The loss of life reported from districts was 127 out of which 100 were in the Sadar Sub Division alone. The town was cut off for about five days and the Siliguri-Kalimpong railway line was washed away. The larger portion of the Kurseong – Darjeeling railway line was also washed away and the said railway line was not relayed until 1951. The Siliguri – Kalimpong line was closed forever as the hill side in that region was considered unsafe. (Dist. Gazzette - 1980). Due to incessant and heavy rain (809 mm for 3 days) between 3rd and 5th Oct '68 there were numerous landslides big and small accompanied by unprecedented floods in Tista and other rivers. On October 5th alone, the rainfall was 490 mm. The landslides so disrupted the communication network that it took several days before the full measure of damage was known to Calcutta and Delhi. The overall death toll officially estimated on 12th October was 677 and unofficial report placed figured much higher. The Rangpo Bridge on Sikkim border along Tista-Gangtok Highway, the magnificent one span concrete bridge on the Tista River near Tista Bazar and several other bridges at strategic points were all gone. Further down the river the Shevak Railway Bridge was severly damaged. The Balason river bridge and the nearby Duhia Bustee in P. S. Kurseong were swept away. In the Toonsong division of the Dhutaria Tea estate, 61 death was reported. In the recent past, the landslides following the heavy rains on 12th July '96 had mostly affected the Kalimpong hills. The southern slopes of Kalimpong hills and the Jaldhaka valley falling in Kurseong Sub-division was mostly effected on these landslides. The loss of life reported to be around 30 in this devastation.

To mention among the last is the landslides of 7th July '98 where in the most effected areas was Kurseong Sub-division, effecting NH-55 near Paglajhora and other roads from Bagora to Mamring. The loss of life was reported to be 7, the extent of damage in the road in near Paglajhora was so much that the traffic could not be restored before three months.

This entire incidence has been put together in a 1:50,000 map prepared by GSI wherein the concentration of such landslides can be estimated and co-related with other factors.

General Slope

By contouring the slope percentage, following Wentworth's method described in Raize's Cartography, The study of the slope character was carried out. Following this method number of contours intersected within one Sq. mile grid were counted and computed.

In Darjeeling District, the slope percentage is ranging from

i) below 40%

ii) between 40% to 70% and

iii) 70% which was prepared by GSI in 1984 in 1:50,000 scale. The higher value of 70 to 80% were found to be restricted within gneissic rocks at higher elevation, mainly to the western part and some portions of the north eastern corner of the area. The most common slope contours were found to range between 40% to 70%, well distributed in the entire area. Contours below 40% were found to occur towards the foothill areas, maintaining parallelism with the orographic trend. The inter-relation between slope gradient and stability could not be ascertained, as the steeper slope areas ranging between 70% to 80% were found to be free from slide incidences while maximum concentration of slides was obwerved between 40% to 50% slope. The rock competency and slope percentage remaining same the direction of slope was found to have played an important role. The slope facing is souhwest monsoon was observed to be more slide prone e.g. the sough-western slope of the Kalimpong hill and the south-westerly flowing Rilli catchment. A slope mapping programme in an around four Municipal towns of Darjeeling district has been taken up by Eastern region of G.S.I.

Rainfall

Next to degree of slope, water is very important factor in causing instability of slope. A very high intensity rainfall of the order of 20 to 30 cm. within 24 hrs. is not uncommon and has reportedly occurred at least 42 times during the period from 1891 to 1975 (Chatterji 82).

Table - 2

(Annual Rainfall in cm.)

Year / Month	Darjeeling	Jalpaiguri	Cooch Behar
Normal	3,212.0	4,136.0	3,193.0
1990–Annual	3,810.0	3,434.0	3,157.0
1991–Annual	3,843.0	3,903.0	3,064.0
1992–Annual	2,729.0	2,820.0	2,354.0
1993–Annual	3,045.0	4,085.5s	3,254.0
1994–Annual	2,448.0	2,521.0	1,972.0

Source : Economic Review 1995-96

The Isohyet map GSI based on the overall annual rainfall data of the last 25 years from different observation of different agencies, shows the value increased from west to the east and maximum concentration of landslides fall between 210 cm and 410 cm of the Isohyets. The higher rainfall area do not have landslides incidence, these are generally covered by dense virgin forest. Though the detailed morphometric analysis and identifications of drainage density texture ratio etc may have co-relation with rainfall distribution, however, it has not been tried so far. This exercise will have to be undertaken in a very systematic manner and that is water shed management along with measurement of flow through different Nullahs and Jharnas. This information co-related with landslides distribution maps can provide immense information for control landslides causes of regional and local prone areas.

Tabel - 3

Darjeeling District : Special Weather Phenomena

Mean No. of Days with	Jan.	Feb	Mar	Apr	May	Jun	Jul.	Aug	Sep.	Oct.	Nov.	Dec.	Annual
Darjeeling Town													
Thunder	0.4	0.1	3.8	6.9	6.9	2.6	1.6	1.6	1.5	0.3	0.1	0.1	25.9
Hail	0.3	0.4	1.0	1.1	1.4	0.1	1.4	0.1	0.0	0.0	0.0	0.0	4.3
Dust Storm	0.0	0.0	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
Squall	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3
Fog	5.2	5.9	4.8	1.9	10.9	19.0 1	21.1	21.9	15.8	3.0	2.8	2.4	114.8

Darjeeling District : Special Weather Phenomena

Mean No. of Days with	Jan.	Feb	Mar	Apr	May	Jun	Jul.	Aug	Sep.	Oct.	Nov.	Dec.	Annual
Kalimpong													
Thunder	0.0	1.2	2.4	6.6	8.9	3.0	3.1	2.8	3.5	0.1	0.0	0.2	31.8
Hail	0.0	0.3	0.3	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1
Dust Storm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Squall	0.0	0.0	0.0	0.1	0.6	0.1	0.1	0.00	0.0	0.0	0.0	0.0	0.9
Fog	1.2	1.1	1.2	1.9	6.8	11.011	14.0	13.7	9.2	3.0	1.2	0.7	65.1

Source : W.B. district gazetteeres, 1980

Competency of rocks

The lithostratigraphic unit of Darjeeling District after modification with reference to rock competency against sliding, on the basis of research of physical properties of rocks at various engineering sides and applying the general working experience in the area GSI has classified the following competency parameters.

1) More competent rock	Gneisses of the Darjeeling and the Kanchanjungha groups.
2) Moderately competent	Sandstone of the Siwalik group.
3) Less competent	High grade schists, of the Darjeeling group.
4) Poorly competent	Low grade phyllite and quartzite (flaggy in nature) of the Dalling group
5) Structurally disturbed Rocks	Mylonitic gneiss and carbon physical occurring at the sole of the thrust.
6) Rocks of the inter-thrust zone	Tectonic slices of the Gondwana Buxa group of rocks occurring in para-autochthonous belt.

Source : G.S.I. report

It has been observed that the poorly competent rocks and the structurally and technically disturbed rocks happen to be maximum slide affected areas. The Daling phyllite consisting predominantly more so when they are interbedded with or overlain by more resistant but fractured quartzite. Highly sheared tectonic slices, mylontic gneiss and pulverised carbonaceous phyllite often slide extensively.

Economy

The economy of the hill areas of Darjeeling District mainly based on agricultural forestry and plantation. In recent years large scale destruction of forests without replantation of trees has diminished the forest wealth considerably. About 21% of the forests have been noted to be semi deciduous in nature. They are grown in the upper hill region, which receives higher rainfall than the foot hill and therefore the bulk of the forests are situated between 2000M and above. There is a conspicuous absence of forests between 1000 to 2000 M as most of the areas have been cleared either for tea and other cultivation. All types of forests viz. Tropical in the foothills, subtropical in the middle and temperate and subtemperate forests in the upper hill, are found in Darjeeling District. An about 32% of the total trees are to be deciduous in lower altitude, their percentage are 12% in both the middle and lower hill areas. Evergreen are 6%, 1.5% and 9.2% in the lower middle and upper hills. Semideciduous trees are 10% in the upper hills, 7% in both the lower and middle hills.

Table - 4

Year	Arable land in Sq. Km.	Year
1901	19.76	1554
1911	23.45	1554
1921	21.39	1481
1931	20.38	1427
1941	24.50	1414
1951	36.67	1430
1961	31.92	1432
1971	44.51	1372
1981	5.61	1204
1991		1155

Areas with intense deforestation

The hill areas of Darjeeling District is divided into three forest divisions namely Darjeeling, Kurseong, and Kalimpong. The growing pressure of population of forests land during last two decades was very high and a sizable amount of forest land were encroached for different purposes as it has been done in almost all hill regions of the country. This resulted a continuous decline of forest cover in the entire district. In the last century, about 19% of the forests cover declined in the major ranges of the district, they were observed in Darjeeling, Takdah and Ghoom-Simana areas of Darjeeling division. In Kurseong division about 5% of the forest cover were reduced during the period, they are mainly in Kurseong, Sukhna, Bagdogra and Phankhabari ranges in this district. All the slopes of the hills in this division have very poor vegetation. In Kalimpong Division, about 26% of the forests were reduced due to expansion of agriculture and human settlements. The ranges which have high decline in Kalimpong sub division are Kalimpong, Chel, Jhaldhaka and Phankhabari. The two tables Table 1 and Table 2 displays reduction in percentage of forests cover in Darjeeling District from 1901 to 1991 and also the police station wise forests cover the areas in Darjeeling District. From the Table 1 it is seen about 23% of forests cover was reduced during this century. The percapita forest cover has also reduced considerably. consequently the agricultural areas was increased from 19,11% in 1901 to 56.41% in 1991. However the rate of decline in Kurseong division was comparatively less because of protected forest in this division. The rate of decline in Tea Garden, forests, was about 44% in this district. It was found that the marginal areas of the forests were clearly degraded due to human activities specially near the Hillcart Road and other main thoroughfare in the hill areas of the district.

Type of Afforestation

Steeper planting social forestry are some of the major Afforestation programme in the hill areas of Darjeeling District and mostly maintained by Forest Department and are located in higher elevation of the hills. Very recently several Afforestation Programme are initiated in the slide prone areas of the steep slopes of the hills specially at the deforested and degraded forest areas. Agro forestry, Silviculture and enter cropping are also some of the programmes undertaken in the forests of the hill. Participatory forests management programme are also being introduced to protect the forests in the hills as well. It is seen from the available records of the forest division of Darjeeling District that most of the expenditures incurred are mostly maintaining all the forests as corrective measures in terms of soil conservation and spend for construction of different engineering structure, they are Sausage, H. P. Wall, CW drain, Palisade, Wattling etc. It is felt that though the engineering part of Afforestation is well taken care of, the vegetation is somehow not receiving the adequate attention. A few tables has obtained from the Divisional Forest Officers of Kurseong, Kalimpong and Darjeeling is enclosed with for assessing the possible financial impact on maintenance of forest in the district.

Area of immediate attention

As we have already discussed the broad areas of Afforestation Programme, some specific and calculative measures is required to be taken for conservation of such areas, Remote Sensing Techniques, can be applied for management and conservation of forest resources in the inaccessible areas of the hills. It helps to identify the diseases of the trees and amount of deforestation and areas of degradation without going to the field. Satellite imageries of these areas are essential for studying the forests of all the hills of the district. A priority is required to be given in the slopes of Hill Curt Road and in the marginal areas of reserve forests along with tea gardens forestation of all the three divisions. To mention specifically Kurseong and Sukhna ranges of Kurseong Division, Ghoom-Simana Darjeeling ranges of Darjeeling Divisions are severely affected by human activities. Afforestation programme in these ranges are urgently required.

Soil Conservation and Erosion

Soil erosions and its conservation plays an important role in the hill areas because it pays a pivotal role in the socio economic conditions of the hills. The type of soil with areas and its conservation is related with the climatic condition of the area along with its geographic situation. Therefore, it becomes necessary to have a soil map of such areas for detailed planning and future programmes. All India Soil and Land Use Survey Organizations under Ministry of Agriculture, Govt. of India had carried out certain specific work in Darjeeling District in priority water shed areas. The main objectives of soil survey were to define describe, demarcate and classify various kinds of soil and interpret the data to determine the land potentialities and other useful priorities for each unit. This covers almost 70% of the inhabited areas of the Darjeeling District. The area of the water shed mentioned above with their details are listed in the following tables.

The soil type varies so much in slope, degree of erosions, stoniness and rockiness and other features effecting their use that it would be difficult to conclude for a practical suggestion about their management from the report.

Soil studied in Darjeeling District have developed generally from Darjeeling gneiss and schist complex parent material. It is observed that the surface derives of all soil loamed areas followed by heavier one at the lower horizon in most of the soil excepting the Teesta Valley and Tik showing a clear illuviation of fine material the lower horizons which has been supported by the presence of argillians described in the morphology while studying the pedons in the field. All the soil are definitely acidic in nature with tendency to increase slightly in depth in most cases indicating the leaching of bases from surface and accumulation in the lower horizons.

Areas proned soil erosion

It would be difficult to assess from the available regional report to conclude and demarcate definite areas which are prone to soil erosion. However, it is to be noted that these are nodal areas of soil erosion and related which is finally responsible for protection measures in the landslides. Characterization and the detailed analysis of the soils will be extremely useful for plantation, agricultural developments, forestry and other engineering construction. It is felt that a detail soil analysis and agricultural programme required to be taken up immediately by adopting the modern technology like GIS and Water Shed Management Analysis, so that certain specific areas can be identified and specific preventive measure of soil erosion can be handed more effectively.

Soil deposition at Darjeeling hill areas are found nil with respect the plain areas of the sub division where soil deposition are mainly due to of river Mahananda, Balasan, Jaldhaka. Neora, Kurti, Chel & Murti rivers. It is understood that the entire hill areas of Darjeeling does not get any soil deposition and only erosions therefore conservation of soil become essential for the hill areas. The average run off calculated from average rain fall of 2681 mm for the last 12 years is 804.30 mm as calculated by Executive Engineer District Division, DGHC.

Possible preventive measures

No systematic soil mapping is being carried out at present in the entire district neither for its conservation nor for its erosion prone areas. The lost, of soil is also not estimated from the landslides which is the frequent phenomenon every year. However, the huge cost running into few crores are required to be undertaken for the damage and restorations of the areas, where soil has being eroded. It is clear from the expenditure being incurred towards bank protection and soil conservation is maximum, but preparation of basic map is not being encouraged so that areas needed to be prioritical for such protection can be identified.

Land use Pattern

The effect of land use on slope stability appears to be complex, as because certain type of land use may definitely promote the stability while in other areas it may not. The land use map of Darjeeling showing agricultural, tea and medicine plants and construction activities in urban areas along with rivers and rivulets in presently available in 1:50,000 scale which has been compiled by GSI from different sources. It is not very clear from this map whether such land use map is comparable in any way with influence of rock competency slope and pervious history of landslides on slope stability. However, the present land use in Darjeeling Himalayan is thus evolved in a continuation of British policy intents, with large tracts sealed off from public use by designation as forest or as private lease lands (e.g. tea garden areas). With very little of the western region of the district being settled under agriculture cultivation, settlement density is higher there since no restrictions on regional population that can be supported apply here in terms of a requirement of keeping agricultural holdings above minimum working size. Another feature, that follows from this settlement vis-a-vis land use pattern is that the land pressures that follow from the growth of population have highly differential impact on the district. In the western region, agricultural development is stymied by the twin constraint of its expansion along the extensive margin by extremely limited private access to land since the major area falls under either forests or tea and by agriculture along the intensive margin debarred by topographical difficulty and adverse climatic situation. Highest lease-land commitments to tea and lowest agricultural usage occur correspondingly high. To the east, Kalimpong block with generally lower elevations has general topographic and climatic predisposition towards rice and maize/millet based cropping, with the rest of the subdivisional low lands along terai harbouring large reserve tracts of deciduous hardwood species that render from conducive to present and future revenue forestry.

The problem associated with current land use in Darjeeling Himalayan become mainly with high settlement of population density, that there is limited scope of further investigation of cultivation on land classified for agricultural use. Preliminary case of shortages of land reserve for cultivation has been consequently exhausted.

One aspect of land use which never got the pre-dominant notice from any of the observ so far is the intensive net work of primary, secondary and tertiary of Nullahs, Jhoras in different basins and catchments. As it is known that a major catchment area receives huge amount of rainfall for a stretched period of monsoon month, the major land use pattern covering these basins with the tributaries have remained unused for any purpose for social utilisation. If water shed management or basin or catchment management either would have been conceived even for water supply or for irrigation in a pilot project basis, the majority of the problem regarding soil erosion through these drainage basins could have been reduced. This will also make control drainage system in parts of the hills, thereby utilising a huge unused portion of land of Darjeeling district for effective utilisation.

Roads of Darjeeling have never been examined with its carrying capacity or its dynamic load bearing capacity. Since the beginning of the century the number of major roads remain unchanged. A majority of the road net work is through the tea estate or the forest areas restricting public movement along those roads. This is indirectly increasing the traffic load for the remaining areas of communications due to increase in urban population along with the increase in trades and commerce. The damages in the road become unavoidable and obvious. Proposition of alternative roads or the maintenance of the roads through the tea garden and forest, which can be used by the other people also, should be considered on an emergency situation so that the loads in these major roads can be decreased. As we have already seen due to the landslides of 1998, the railway track between Tindharia and Kurseong where the road conditions does not permit communications by the toy train as it cuts the subsidence zone near Paglajhora. Keeping in mind the heritage value of this railway track, the portion between Kurseong and Darjeeling can be kept and maintained properly either for the tourist or even for the use of local populations.

Considering the different aspects of the land use it may be necessary to select certain predominant areas where the land use map in a larger scale, 1:25,000 or 1:10,000 as the necessities may be, might have to be undertaken immediately by certain agencies, Govt. or otherwise, which will form the basis of future planning.

General Strategy for Focussed Area

While analysing the above information assimilated from different source, a clear picture emerges out for future strategy and actions. The entire area can be subdivided into three major components, 1, 2, and 3 which can further be identified as Municipalities as Component 1, Roads and Highways as Component 2 and other selected areas of the district as Component 3. The strategy and the Action plan are both goaled for a better quality of life for the people of Darjeeling district in particular and for the protection of Ecosystem in general. The following steps are required to be adopted for control and mitigation of landslides in different component areas :-

Immediate Step

a) Identification and mapping of hazard prone areas in 1:25,000 or 1:10,000 scale.

b) Mapping of drainage pattern in form of basin and catchment area.

c) Interaction with local authorities and develop local expertise in light social preventive measures.

Intermediate Step

a) Preparation of growth pattern map for Municipalities, Roads & Highways and Block wise in case of Component 1, 2, and 3.

b) Examination of Culvert and Roads with their capacities of Maximum Discharge.

c) Arrangement for local experties for discharge measurement, rainfall data collection and their trend analysis over time and space.

Final Step

a) Preparation of terrain model.
b) Development of Water harvesting System and storage pattern.
c) Interaction with Municipalities and local bodies for change in Building Rules & other legal aspects for development control.
d) Suggest hard ware components with technique time and cost.

Special Strategy

Participatory Concept :- A participatory concept for control of landslide is nothing new. It helps to develop the existing local knowledge and gives them a scientific model for execution. There is few character of landslide, which can only be ascertained only with a perfect monitoring system, and these can be possible if a local base is developed.

a) *Earliest stages of ground instability :*
    i) appearance of new springs or seeps on sloping ground,
    ii) intermittent creaking of trees (except by wind),
    iii) elevation change or road, flat area, canal etc.,
    iv) small soil runs,
    v) movement of rock mass or boulders downslope and
    vi) Constriction of stream channel.

b) *Advancing stages of instability :*
    i) continuous ground cracks; emerging pattern of ground cracking,
    ii) bulging at base of slope
    iii) continuous reveling or minor displacements on surface of a slope,
    iv) increasing frequency of sound emission,
    v) appearance of new rapids along a defined stretch of the stream bottom,
    vi) increasing turbidity of stream flows
    vii) appearance of ground holes
    viii) Strange animal behaviour.

c) *Advance stage of movement :*
    i) cracks running perpendicular to slope contour,
    ii) zones of disturbed earth
    iii) zones of distributed vegetation,

iv) ponding of surface water at new locations,

v) relatively frequent runs of soil,

vi) breakage of blocks of earth or rock on steep slopes,

vii) loud noises emitted from the subsurface,

viii) Disturbance of cultural features (pavements, pipelines, foundations, embankments, etc.)

ix) Sudden cessation of flow in a drainage.

A community base water shed management on the basis of information obtained for physical characteristic (e.g. Rainfall, terrain etc.) and community perception regarding utilisation of physical resources will always be more effective than an imposed technology based concept in such ecologically sensitive areas. The resolution on plan have to emerge from community through a focussed group discussion with community. The priority of the people will provide direction and focus to the implementation. This will involve

- Local initiative
- Local Knowledge
- Local decision making
- Transparency in working, specially at the local level
- Skill development at different levels to respond to varying situations and needs that will arise from time to time.
- Capacity building for stakeholders.
- Better quality of life and greater cost effectiveness.

Brief conclusions from the analysis

The analysis made from the available information requires certain major decisions to be taken for smoother execution for development in respect of landslides.

a) Reviewing of lease term for the sick tea gardens in specific areas of Darjeeling District so that those areas can be brought under controlled development of the District.

b) Certain selected areas are to be brought under regulatory Authority for adoption and application of Town and Country Planning Act;

c) Land Use Development Controlled Plan of detailed development plan is required to be carried out in specific areas where from it has been mentioned as delicate and needs monitoring. Based on these, a perspective Plan can be detailed for future development.

d) A development Controlled Authority has to be declared for the execution and application to Town and Country Planning Act.

Final Conclusion

The analysis of the available data from the physical soil characters & crop pattern, which lead us in a particular conclusions that a good synthesis between these there has to be established for a better futuristic growth pattern and development of Darjeeling District as a whole. A mouza wise analysis with population growth and physical parameters of the area has to be undertaken in different priority areas to save an environmental disastrous occasionally hampering the development potential of the District and also reducing the potential area of the limited available land resources of the hill.

BOOK REVIEW

CONTEMPORARY STUDIES IN HUMAN ECOLOGY

(Editors) M. K. Bhasin and S. L. Malik, Delhi, Kamal Raj Enterprises, 1998

pp XX + 1 – 379, Rs. 550/-

In recent decades many social scientists and Physical Anthropologists have turned their attention towards the study of the ecological problems considering the fact that the human being have direct relation with the environment they live in and human being like all other living organisms interact with the environment constantly for their survival. Any ecological problem therefore, has direct impact on the biological and/or cultural life of the people. In the last century the 'intensity of the environmental destruction has multiplied manifold' (p-v) creating serious threat to the life of all living organisms including human being. Therefore for their own protection, human being had to think about the protection of the environment they live in. Scientists have expressed their concern regarding the problem due to change in the ecological conditions. They have nor only studied the impact of the ecology on living organism including human being and the impact of ecology in the changed circumstances, but also the ecological management and development. The present book under review is also a book through which a number of scholars and academicians have expressed their concern on these issues and also the role of human factors in resource management and development.

There are thirty one articles in the book written by authors representing different disciplines like Anthropology, Botany, Zoology, Human Science, Human Geography, Life Sciences, Environmental Sciences etc. The articles cover period from pre historic period, to the present time thereby giving a very good idea about man-ecology relationship during a very wide range of period. Similarly in the spatial level the articles have covered areas from the Himalayan region in the north to the coastal region in the south. While there are some general articles, but majority of the articles are theme specific. Articles cover different ethnic groups living in the states of Rajasthan, Madhya Pradesh, Kerala, Orissa, Assam, Kashmir, Tamil Nadu, Uttar Pradesh, Sikkim, West Bengal, Himachal Pradesh, Meghalaya and some other States. Many of the articles of this book are very interesting and important.

as the articles are written by the scholars of different disciplines, readers have enough scope to enlarge their knowledge and vision on different aspects of human ecology.

The book is undoubtedly an important contribution in the discipline of Human Ecology. It definitely shows "the direction to integrated research on environmental topics". This book, the proceeding of a National Seminar organised in October 1996, is well edited one and has definitely fulfilled the objective of the seminar i.e. man-environmental relationship. the editors, Prof. Bhasin and Prof. Malik should definitely be congratulated for this rich contribution. Credit also goes to Kamla Raj Enterprises for the publication of this important book.

MANISH KUMAR RAHA

Ex. Jt. Director Anthropological Survey of India

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